THE

# JOURNAL OF GAS LIGHTING,

## WATER SUPPLY, & SANITARY IMPROVEMENT.

[REGISTERED AS A NEWSPAPER.]

VOL. XXVI. No. 658.] LONDON, DECEMBER 21, 1875. [27TH YEAR.] Price 6d.

**RAMSAY'S NEWCASTLE CANNEL**
COAL. Analysis—10,000 cubic feet of gas per ton of coal: 26-candle gas: 13¼ cwt. coke per ton of coal.
The London Exhibition in 1851 was lighted with gas made from Ramsay's Cannel.
RAMSAY'S PATENT CONDENSED COKE.
DO. GARESFIELD COKE.

**RAMSAY'S FIRE-CLAY ARTICLES.**
GAS-RETORTS, introduced 1838. FIRE-BRICK WORKS, established 1804. FIRE-CLAY SANITARY PIPES. CHIMNEY-TOPS, and all Goods made of Fire-Clay. The Fire-Clay is worked from Blaydon Main Colliery, is of excellent quality, and no expense spared in perfecting every article. The FIRE-BRICKS (marked "RAMSAY") are to be seen in all parts of the world, and the Works are the most extensive in the Kingdom.
Manufactories—Derwenthaugh, Swalwell, and Hebburn Quay, near Newcastle-on-Tyne; and London Wharves—Falcon Wharf, No. 80, Bankside; and Honduras Wharf, Cubit Town. Large stocks kept.
Address G. H. RAMSAY, NEWCASTLE-ON-TYNE.

**GENUINE TORBAY PAINT**
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**SPECIAL GASOMETER PAINT**
(Mixed ready for use).
These Paints are now used in 100 Country Gas-Works, and by all (but one) of the London Gas Companies, on Gasholders, Scrubbers, Purifiers, &c. They will cover tar effectually. Also used by the Admiralty, War Office, Railway Companies, Founders, &c.
They prevent and arrest rust, and protect iron from the action of water, sulphurous and gaseous exhalations.
The covering powers are considerably greater than those of any other Paint.—*See "Engineer," Nov. 2, 1866.*
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WORKS: BRIXHAM, TORBAY.

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SPECIALITIES IN WOOD GRIDS
FOR
PURIFIERS & SCRUBBERS
MADE FROM THE BEST QUALITY
OF
WELL-SEASONED PLANKS.
SCRUBBERS FITTED WITH MR. LIVESEY'S BOARDS AT MODERATE COST.
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**JOSEPH COWEN and CO.,**
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Were the only parties to whom a PRIZE MEDAL was awarded at the GREAT EXHIBITION of 1851, for "GAS-RETORTS and OTHER OBJECTS in FIRE-CLAY," and they were also awarded at the INTERNATIONAL EXHIBITION of 1862, the PRIZE MEDAL for "GAS-RETORTS, FIRE-BRICKS, &c., for EXCELLENCE of QUALITY."
J. C. and Co. have been for many years the most extensive Manufacturers of Fire-Clay Retorts and Fire-Bricks in the Kingdom. Orders for Fire-Clay Retorts of all shapes and dimensions, and to fit any shaped Mouthpiece, Fire-Bricks, and every other article in Fire-Clay, are promptly executed at their Works as above.
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THE WEDNESBURY TUBE-WORKS, WEDNESBURY;
AND
THE ALMA WORKS, WALSALL.
*Established at the commencement of Gas Lighting.*
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J. R. and Co. make all kinds of Tubes and Fittings for Gas, Steam, and Water; Gun-Metal Cocks, Stocks, and Dies; Galvanized Tubes and High-Pressure Tubes, &c.
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Also, STATION-METERS, PRESSURE-GAUGES, STREET-LAMPS, REGULATORS, &c.
ESTABLISHED 1830.

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MANUFACTURERS OF
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CAST & WROUGHT IRON TANKS FOR DITTO,
And Gas Apparatus of every Description.
*Marine, Tubular, Cornish, Plain, Furnace, Saddle, and Range Boilers.*
SUGAR, SALTPETRE, AND ALL KINDS OF PANS.
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RETORT-SETTING A SPÉCIALITÉ.
RETORTS SET, AND GUARANTEED TO BURN OFF A CERTAIN AMOUNT OF COAL, OR ELSE NO MONEY TAKEN FOR THE CONTRACT.
PLANS ON APPLICATION.
*Retort-Setters sent to all parts of Europe and America.*
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# IMPROVED DRY GAS-METERS,
WARRANTED TO MEASURE CORRECTLY, AND NOT TO VARY.

**EXTENSION OF PREMISES.**

G. G. & Co. having had their premises entirely rebuilt, are now fairly in possession of large and commodious workshops, specially adapted to the requirements of the trade, and they are prepared to execute orders, large or small, with promptness and despatch.

*THEY KEEP IN STOCK METERS OF ALL SIZES, UP TO 300 LIGHTS.*

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SILVER MEDAL, PARIS EXHIBITION, 1867.

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LAP-WELDED IRON AND HOMOGENEOUS METAL BOILER TUBES.

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OF THE

# FRICTIONLESS DRY GAS-METERS,

Beg to intimate to Gas Companies and others that they are now prepared to supply these very superior Meters at the same prices as for the ordinary Gas-Meters.

In the construction of this Meter, for which the best tin plates only are used, every mechanical contrivance has been taken advantage of successfully to reduce the friction to a minimum, which is amply proved by the fact that they are made to work upon only one-fortieth of an inch pressure. By an improvement also in their construction, a steadier light is obtained, and greater capacity than can be got from any other Meter in the market. No gas can pass under the valves on any back pressure, as is the case with many other Dry Meters.

To Gas Companies supplying gas through streets with heavy gradients, these Meters are invaluable, as much gas is saved from the low pressure required to work them.

ALL METERS ARE UPHELD FOR FIVE YEARS.

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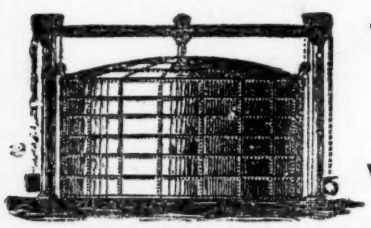

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STATION & CONSUMERS WET OR DRY METERS, STREET & SERVICE MAINS, LAMP COLUMNS & BRACKETS, & WROUGHT-IRON TUBES AND FITTINGS; WROUGHT-IRON ROOFS FOR ANY SIZE OF BUILDINGS.

Sole Makers of B. W. Thurston's Combined Condensing, Scrubbing, and Washing Apparatus,

AND PATENTEES OF THE IMPROVED COMBINED CONDENSING AND PURIFYING APPARATUS SO EMINENTLY ADAPTED FOR EXPORTATION.

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**BUILDINGS, AND SHEDDING,**

For which Estimates will be given on application,

**ERECTED COMPLETE IN THIS COUNTRY**

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PREPARED TO PLAN FOR ERECTION ABROAD,

EITHER WITH

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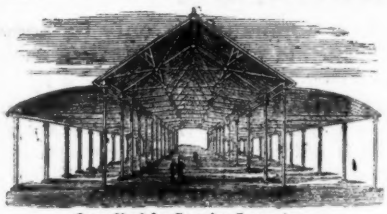
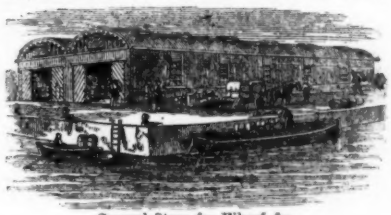


Open Shed for Covering Large Areas.



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GALVANIZED or PAINTED CORRUGATED IRON ROOFING PLATES and TILES. HEAVY CORRUGATED IRON PLATES for FIREPROOF FLOORS, ROADWAYS, PARAPETS, &c. WROUGHT-IRON TANKS, GUTTERING and CONSTRUCTIONAL WROUGHT IRONWORK.

*Designs prepared, and Illustrated Descriptive Catalogue forwarded on application.*

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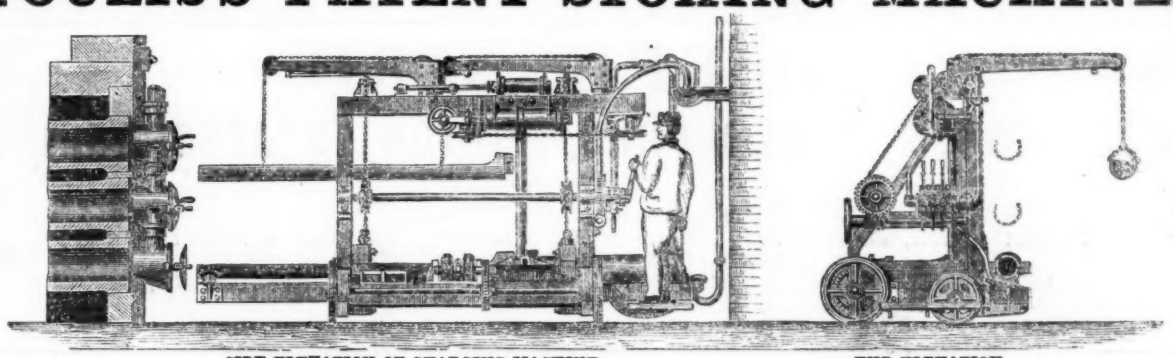
## FOULIS'S PATENT STOKING MACHINE.



SIDE ELEVATION OF CHARGING MACHINE. END ELEVATION.

*(The Drawing Machine will be Illustrated in next week's Advertisement.)*

Makers: **TANGYE BROTHERS and HOLMAN, London and Birmingham; ADAM WOODWARD and SON, Manchester ROBERT LAIDLAW and SON, Glasgow; MASCHINENBAU-ACTIEN-GESELLSCHAFT HUMBOLDT, Kalk bei Deutz;**

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GAS ENGINEERS,

**WORKS: COMMERCIAL ROAD, EXETER,**

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**EVERY DESCRIPTION OF GAS APPARATUS.**

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NEW GAS-WORKS erected complete. Plans and Estimates furnished. MAINS, METERS, SERVICES, LAMPS, &c., adapted for Towns of any size. Gas Companies advised on Improvements, Extensions, and Alterations of Works.

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RETORTS and RETORT-HOUSE FITTINGS, CONDENSERS, SCRUBBERS, ENGINES and EXHAUSTERS, PURIFIERS, STATION-METERS, GOVERNORS, VALVES, &c.

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They beg special attention to the excellence and superiority of their WET and DRY METERS, several thousand being now in use by many of the largest Gas Companies in the West of England and South Wales. Warranted to measure correctly, and not to vary. Their acknowledged superiority has brought them into general use more rapidly than any Meters hitherto manufactured. A guarantee of Five years tendered with each Meter.

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# IMPERIAL METER COMPANY,

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OFFICE: 115, VICTORIA STREET, WESTMINSTER, S.W.,

MANUFACTURERS OF

## "WET" & "DRY" GAS-METERS IN IRON & TIN-PLATE CASES,

STATION-METERS AND GOVERNORS, STREET-LAMP METERS, BOXES, AND REGULATORS FOR THE AVERAGE METER SYSTEM.

TO GAS COMPANIES, ENGINEERS, &c.

**These Works are in full operation, and it will be the aim of the New Company not only to keep** up the excellent workmanship of their predecessors, but, by the introduction of special machinery, to manufacture **Meters of a higher standard than is usually given, without increasing the cost.**

**Special attention is invited to the Compensating Wet Gas-Meter of De Castro and Burton, which** is now becoming so generally adopted, and is more simple in construction than any other Compensating or Ordinary Wet Meter. There is but one centre of friction to be overcome by the gas. By its self-adjusting principle it maintains an unvarying water-line; and the reservoir contains sufficient water to supply the Meter for twelve months without attention. It is unaffected by "tilting," and cannot be "flooded" by any pressure.

**The Company also manufacture Dry Meters upon the most improved principle, and all their** Meters being made to standard gauges, the most accurate measurement is obtained.

**Attention is also called to their Dry Meters in Wood Cases, as used by some of the London Gas** Companies. These Cases are a great preservation to Tin-plate Meters, especially in seaport towns, where the air is impregnated with salt; they are also particularly suited for export.

**The Company repair or convert every description of Wet Gas-Meters to De Castro and Burton's** Patent.

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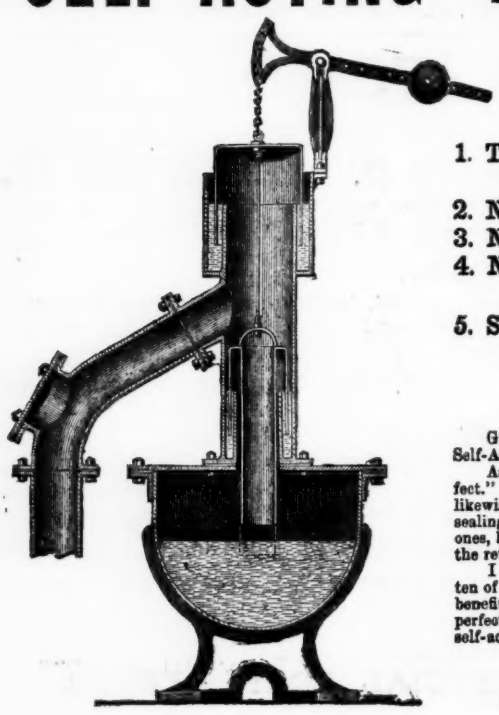
EVERY DESCRIPTION OF TUBING, GAS, STEAM, HYDRAULIC TUBES AND FITTINGS,
EITHER BLACK, GALVANIZED, OR ENAMELLED HOT WATER TUBES AND FITTINGS,
CORE BARS, COILS, COCKS (IRON OR BRASS),
CHANDELIERS, &c., GAS-FITTERS' TOOLS, GAS TONGS, STOCKS, TAPS, DIES, &c., &c.,
HANDRAIL TUBINGS, IRON AND BRASS, PLAIN OR TWISTED,
TELEGRAPH TUBES OR POLES, &c., &c.

# SELF-ACTING REMOVABLE DIP-PIPE,

PATENTED BY

## CHANDLER & STEVENSON.



ADVANTAGES.

1. There is no pressure on the Retorts.
2. No deposit of Carbon.
3. No scurfing is required.
4. Never a choked Ascension-Pipe.
5. Saves Fuel and Wear and Tear.
6. Gets 10 per cent. more Gas out of the Coal, and a higher Illuminating Power.
7. Is never out of order.
8. Requires no attention.
9. Is perfectly automatic in its action.

TESTIMONIAL.

*Metropolitan District Asylum, Caterham, Surrey, Dec.* 14, 1874.

MESSRS. CHANDLER AND STEVENSON.

GENTLEMEN,—I have much pleasure in bearing testimony to the complete working of your "Patent Self-Acting Dip-Pipes," which have now been in constant operation over three months.

As regards the action of the apparatus, I can describe it no better than by calling it "simply perfect." Immediately the retort is charged and the lid secured, the small holder rises, which lifts the Dip; likewise the instant the gas is permitted to escape at the mouthpiece the holder falls, thus perfectly sealing the Dip. I am fully convinced of the superiority of these Self-Acting Dips over Non Self-Acting ones, having experienced the fact that stokers do occasionally neglect to unseal the Dip after charging the retort, thereby causing a waste or loss.

I feel that it is quite unnecessary for me to say more on the subject, excepting that, having had ten of Messrs. Chandler's Dip-Pipes in use more than one year, and having experienced the great benefits derived thereby, inasmuch as the yield of gas from the coal is greatly increased, and the retorts perfectly free from carbon and other advantages, and seeing that the same Dip has been made perfectly self-acting by the second patent, I feel convinced that this is the right thing.—Yours obediently,

W. CRICKMAY, Resident Engineer.

*For terms of use and cost, apply to Mr.* G. W. STEVENSON,

4, WESTMINSTER CHAMBERS, VICTORIA STREET, S.W.

# WILLIAM SUGG,

## GAS ENGINEER,

## VINCENT WORKS, VINCENT STREET,

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## WILLIAM SUGG'S LATEST IMPROVEMENTS IN GAS-BURNERS.

The "LONDON" ARGAND BURNER, with SELF-ACTING GOVERNOR (Patent).

"Westminster" Pattern Shade, as used in the Ministers Rooms and Lobbies of the Houses of Parliament.

This Burner is No. D size, and, with a consumption of 5 cubic feet per hour, gives about 2 candles more light than the Gas Referees model, called the No. 1 "London" Argand Burner.

Numerous other pattern Shades, Plain or Ornamental, may be obtained with these Burners.

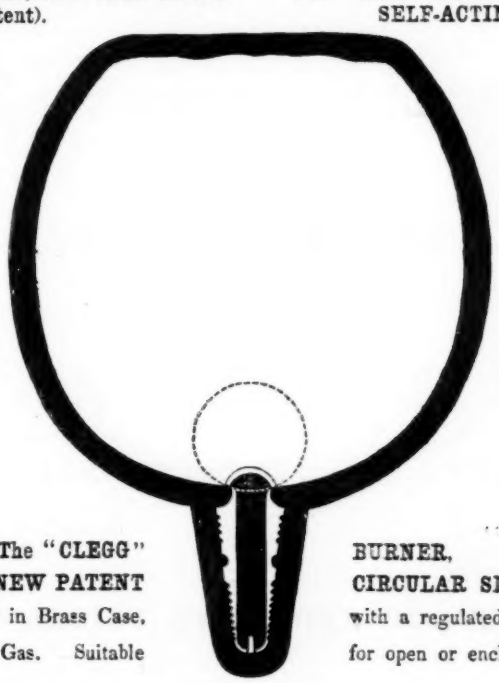
The "CHRISTIANIA" FLAT-FLAME BURNER, with SELF-ACTING GOVERNOR (Patent).

This Burner has been pronounced by the most eminent Engineers of the day to be the perfection of a flat flame Burner.

The Shades, which are made in a beautiful white glass called Albatrine are manufactured *exclusively* for these Burners, and cannot be obtained elsewhere.

The light emitted from these Burners is very white and soft to the eyes, and is about 30 PER CENT. superior to the ordinary fishtail.

The Shades may be had either Plain or Ornamental.



The "CLEGG" BURNER, with the NEW PATENT CIRCULAR SLIT.

Is a flat-flame Burner in Brass Case, with a regulated opening for the admission of Gas. Suitable for open or enclosed Lights.

**Price Lists and Prospectuses, with description of all the "London" Argand and other Burners, and their proper Shades, Supports, &c., forwarded post free on application.**

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## CHARGING AND DRAWING GAS-RETORTS,

**And to enter into arrangements with GAS COMPANIES for its use upon moderate terms of Royalty.**

The Patented Machinery has secured the approbation of all Engineers who have visited the MAIDSTONE GAS-WORKS, *where it is in full operation, and may be inspected at any time on application to the Manager.*
The advantages attending its use are—

**INCREASED VOLUME OF GAS PER TON.**
**INCREASED YIELD PER RETORT.**
**INCREASED BULK OF COKE FOR SALE.**
**REDUCTION IN LABOUR AND LESS DEPENDENCE ON SKILLED STOKERS.**

**A Pamphlet containing a description of the Machinery, and Copies of Reports on the working of the same, &c., will be forwarded on application to the MANAGING DIRECTOR, Maidstone. Communications may also be addressed to R. P. SPICE, Esq., or to F. W. HARTLEY, Esq.**

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**Manufacturers of**

## CAST-IRON GAS AND WATER PIPES.

**SIZES: ¾ to 12 inches at GLASGOW.**
**„ 1½ to 7 „ STOCKTON.**

**A LARGE STOCK KEPT, AND PRICES MODERATE.**

**Freight to London, in the Stream, 10s. per ton from Stockton; 12s. 6d. from Glasgow.**

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## LAURENCE POUNTNEY LANE, LONDON, E.C.,

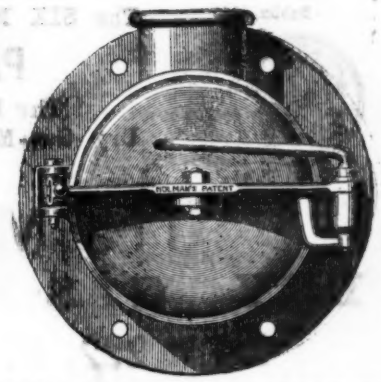
SOLE MAKERS OF

## MORTON'S PATENT SELF-SEALING RETORT-LIDS,

WITH

## HOLMAN'S NEW PATENT BRACKETED CROSS-BARS,

Anti-Friction Catches and Eccentric Fastenings.




**INSTANTANEOUS SEALING EFFECTED.**
**NO LUTING. NO DUPLICATE LIDS REQUIRED.**
**HOLMAN'S NEW SELF-SUSTAINING CROSS-BAR ENSURES FREEDOM OF JOINT AND MAINTAINS PARALLEL POSITION OF THE LIDS.**

Since their introduction in 1869, these Patent Retort-Lids have been thoroughly tested (rigid cast iron is now successfully employed), nearly 20,000 being in use at various Gas-Works in London and the Provinces, among which may be mentioned:—

The Gaslight Co., Beckton (where, by the end of 1875, nearly 4000 will be in use).
" Gaslight Co., Bow Common.
" Gaslight Co., Silvertown.
" Gaslight Co., Lupus Street.
" London Gaslight Co.
" Independent do.
" Phœnix do.
" South Metropolitan Gaslight Co.
" Commercial do.
" Imperial do.
" West Ham Gas Co.
" Gas-Works, Barnet.

The Gas-Works, Royal Arsenal, Woolwich.
" do. Lower Sydenham.
" do. Brentford.
" Consumers Gas Co., Woolwich.
" Alliance and Dublin Gas-Works.
" Edinburgh do.
" Manchester Corporation do.
" Salford do. do.
" Rochdale do. do.
" Liverpool Gas-Works.
" Birmingham do.
" Birkenhead do.
" Nottingham do.

The Newcastle-on-Tyne Gas-Works.
" Lurgan do.
" Carmarthen Gas-Works.
" Merthyr Tydfil do.
" Windsor do.
" Leeds do.
" St. Albans do.
" Over Darwen do.
" Rotherham do.
" Aylesbury do.
" Bournemouth do.
" Ystrad do.
" Cardiff do.
" Rochester do.

The Keighley Gas-Works.
" Aberdare do.
" Ballymena do.
" Richmond do.
" Stalybridge do.
" Longton do.
" Exeter do.
" Ross do.
" Falmouth do.
" Barrow-in-Furness do.
" Belfast do.
" Wakefield do.
And other Provincial and Foreign Gas-Works.

## IMPORTANT TESTIMONIAL.

*The Gaslight and Coke Company (Commonly called the Chartered Gas Company), Beckton, North Woolwich, July 2, 1874.*

MESSRS. TANGYE BROTHERS AND HOLMAN.

Gentlemen,—In answer to your inquiry respecting the Self-Sealing Lids, I beg to say that they continue to work well, and I have every reason to be satisfied with them.

I should be very sorry to return to the old system of Luting, and our stokers here freely acknowledge the benefit to them of the new system.

I am, yours truly,
(Signed) G. C. TREWBY.

VIENNA EXHIBITION, 1873.—The highest prize and only Medal "for Progress" for Direct-Acting Steam Pumps for general purposes was awarded to TANGYE BROTHERS AND HOLMAN, Engineers, London, for

## THE "SPECIAL" DIRECT-ACTING STEAM PUMPS.

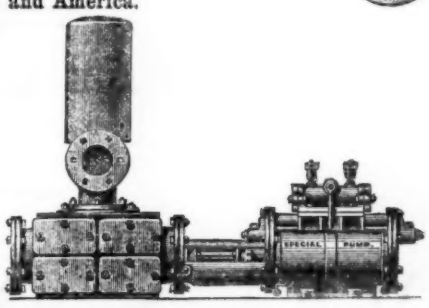
**Upwards of 12,000 have been sold in England and America.**

### In use in upwards of a Hundred Gas-Works in the United Kingdom for Pumping Ammoniacal Liquor, Water, or Tar.

**Intending Purchasers are particularly requested to observe the great length of stroke of these Pumps, as compared with the short stroke of Pumps of other makers, as the durability of the machine greatly depends upon this.**

**The following sizes are those usually supplied to Gas-Works. Those marked, * being usually selected for pumping Tar and Liquor, are nearly always in stock, fitted up expressly with Pump details in iron, and extra length distance-piece between steam and pump cylinders, at a small extra cost.**

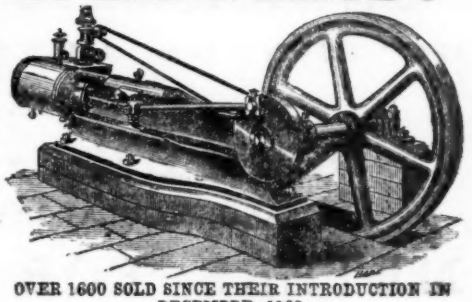
| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Diameter of Steam Cylinder . in. | 3 | *4 | *5 | *6 | 5 | *7 | 6 | *8 | 7 | *10 | 10 |
| Diameter of Water Cylinder . " | 1¼ | 2 | 3 | 4 | 5 | 5 | 6 | 6 | 7 | 7 | 8 |
| Length of Stroke . . . . . " | 9 | 9 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 18 |
| Gallons per hour approximate . | 450 | 815 | 1830 | 3250 | 5070 | 5070 | 7330 | 7330 | 9750 | 9750 | 13000 |
| REDUCED PRICES. . . . | £16 | £18 | £22 10 | £30 | £27 10 | £40 | £40 | £50 | £50 | £65 | £75 |




## TANGYE'S HORIZONTAL HIGH-PRESSURE EXPANSIVE STEAM-ENGINES.

In designing this Engine the utmost regard has been paid to simplicity of arrangement, strength of construction, and economy in cost. The working parts are considerably reduced in number, as compared with Horizontal Engines generally, rendering it far more durable and compact, the bed-plate, front cylinder cover, guides, and plummer-block for crank-shaft bearing being all cast in one piece, which in design and proportions is admitted by competent engineers to be perfect, and to afford a strength and rigidity that cannot possibly be attained in the best fitted engines of the ordinary horizontal type. The extraordinary stiffness of this Engine will permit of its being driven at a much greater maximum speed than engines generally, and with far less wear and tear. The cylinder with its valve-chest is bolted to the end of the bed. The cross-head slippers and connecting-rod ends are made adjustable, so that any wear can be readily taken up. The fly-wheel, cylinder-end, connecting-rod, and crank-plate, are all bright. All the parts are made to Whitworth's Gauges, and the material and workmanship are of the highest class throughout.

The Governor is of a very special description, and combines in the small space usually occupied by the ordinary steam stop-valve, a governor, throttle-valve, and stop-valve complete. It is exceedingly sensitive, simple, and compact.



**These Engines are adopted in Gas-Works at Greenwich (Phœnix Gas Co.), Haggerston (Independent Gas Co.), Nine Elms (London Gas Co.), Falmouth, Harrow, Jersey, Plymouth, Richmond, Rochdale, Santiago (Chili), &c.**

**OVER 1600 SOLD SINCE THEIR INTRODUCTION IN DECEMBER, 1869.**

London 1851. New York, 1853 Paris, 1855. London, 1862.

Dublin, 1865

The SIX MEDALS AWARDED to THOMAS GLOVER for

**PATENT DRY GAS-METERS,**

The latter being the Highest Medal awarded for Dry Gas-Meters by the Imperial Commissioners for the Universal Exhibition, Paris, 1867.

Paris, 1867.

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LONDON, E.C.

**THOMAS GLOVER & CO.'S PATENT DRY GAS-METERS,**

1st, Are a remedy for all the defects of Wet Meters;
2nd, Are suitable for all climates, whether hot or cold;
3rd, Incur no loss of Gas by evaporation;
4th, Cannot become fixed by frost, however severe;
5th, Are the most accurate and unvarying measurers of Gas;
6th, Prevent jumping or unexpected extinction of the Lights;
7th, May be fixed either above or below the level of the Lights;
8th, Cannot be tampered with, without visibly damaging the outer case;
9th, Will last much longer than Wet Meters;
10th, Will not cost more than one-half for repair that Wet or Water Meters do;
Are upheld for five years without charge.

# WILLIAM PARKINSON & CO.,

(SUCCESSORS TO SAMUEL CROSLEY,)

**COTTAGE LANE, CITY ROAD, LONDON, E.C.**

**Established 1816.**

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## STATION-METERS WITH PLANED JOINTS,

GOVERNORS, PRESSURE REGISTERS, GAUGES,

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## STREET-LAMP METERS,

AND REGULATORS FOR AVERAGE METER INDICATION.

## METERS FOR MEASURING WATER.

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## NOTICE TO SUBSCRIBERS.

*In consequence of the Christmas holidays, the next Number of the* JOURNAL OF GAS LIGHTING *will not be published until Wednesday, Dec.* 29.


# THE JOURNAL OF GAS LIGHTING,
## WATER SUPPLY, & SANITARY IMPROVEMENT.

*TUESDAY, DECEMBER* 21, 1875.


## Circular to Gas Companies.

WE are very much afraid that the scheme for the general amalgamation of the metropolitan gas companies has been dropped, at all events, for the present. In what way it can be revived, as it must be shortly, will require grave consideration. The reasons which keep the companies apart can be readily appreciated, if not sympathized with. If wisdom had prevailed in their councils, a proposal to amalgamate would have emanated, spontaneously and simultaneously, from every one of them. They might have proposed to combine under the title of an Alliance, United, or General Company, or under any other name they thought fittest and best. It ought not to have been left for one company, not even the oldest, at this conjuncture, to invite the rest to combine, under a name which, after all that can be said, will always be honoured. The Chartered Company, as we said before, have taught the whole world the art of gas-making, and deserve the gratitude of every gas consumer. That they have worn out capital is no wonder. It may well be that the cost of George Stephenson's first locomotive is still represented in the capital account of a railway company, and in the capital account of the Chartered Company there may still be represented sums expended which can only be considered productive, in so far as the expenditure has contributed to make the manufacture of gas the almost perfect art it is at the present day. Speaking for ourselves alone, and without a suggestion from any quarter, we may say that, the gas companies might have deemed it an honour to be associated together under a name which will always hold a place in history. But it seems that this will not be agreed to, and we have to consider alternative arrangements.

The first is the possibility of purchase—a question which, as we said last week, is cropping up everywhere. In relation to this, comes the inquiry, Who is to purchase? That any Government would allow the metropolitan authorities, as at present constituted to have the control of the gas and water supply, no one for a moment dreams. The interest of the Corporation of the City of London in these matters is so infinitesimally small, in relation to the rest of the metropolis, that they may be left entirely out of consideration. The Metropolitan Board of Works are so constituted as to be a caricature of local self-government. They are mistrusted by all parties, and are only endured in consequence of the apathy of ratepayers who know that they will be taxed, and do not care who taxes them. The only other reason for their existence is the laziness of Government, who decline to trouble themselves with the complex question of the administration of metropolitan affairs. It is a sufficient condemnation of the two authorities to say that, no proposition for the efficient municipal Government of the whole Metropolis has ever emanated from either body. No one is surprised at this, for every one recognizes the fact that the conception of a scheme for the purpose is beyond the capacity of any present member. Could the services of—say the Town Council of Birmingham—be transferred to London, we should have the matter settled in a year or two. As it is, vestrydom will continue to reign outside the City of London, and dinners will continue to be eaten within the City, and the "confusion worse confounded" which exists in metropolitan affairs will, for some time longer, prevail. With these remarks, we may at once dismiss the question of purchase by the authorities.

The whole question, however, is not settled when the authorities are dismissed. There remains the possibility of purchase by Government, or, at all events, under Government supervision. We do not suppose that the metropolitan gas companies will ever be purchased for the advantage of the Consolidated Fund. It is true that the telegraph companies have been bought with a view to reduce taxation, and that the railways may eventually be taken over for the same purpose. It is true also that the Government have bought Canal shares to a large extent—with what view is not yet clearly apparent—but we do not suppose it has yet been decided to expend some fifteen millions in the purchase of the London gas companies. The probabilities are, that, if any scheme of the kind be entertained, it will be something like that proposed last year—viz., the vesting of the undertakings in a body of Commissioners, who shall administer them so as to secure to shareholders and proprietors, annuities equal to maximum dividends, and sell gas to consumers at the lowest possible price. It will be remembered that one of these Commissioners was to be appointed by the gas companies, one by the local authorities, and one by Government. There is much to be said in favour of such a proposal, for (as would have been the case in the event of the general amalgamation of the companies) there can be no doubt that the combined undertakings, with efficient management, might considerably benefit consumers. We say nothing about reduction of taxation, which is, however, practically accomplished when the price of gas is reduced. It is needless here to repeat our constant argument, that gas profits applied to public improvements are, as a matter of fact, the additional taxation of a gas consumer, no matter what the price of gas may be.

But supposing a scheme carried, such as is here, once again, described; then comes the all-important matter of the appointment of the Commissioners. We are not exactly in love with Government officials, and cannot regard the appointments hitherto made, in connexion with metropolitan gas affairs, as particularly happy. The Government of the day, whoever they may be, have an infinite number of barristers, "of not less than five years standing," and of half-pay officers, together with some newspaper writers, on their books, waiting for whatever may turn up. The choice of the Government, therefore, cannot be calculated upon, beyond the probability that it would fall on some one who had not the smallest knowledge of gas affairs. As regards the Metropolitan Board of Works, it is not difficult to guess upon whom their choice would fall, if the appointment were worth, say, £1000 a year. The companies have the pick of a number of gentlemen, all well skilled in the management of gas undertakings, and, although the selection would be difficult, they could hardly make a mistake. So much as regards the scheme, which is again somewhat in vogue, and may be heard of again next session.

A few words must be devoted to the consideration of the Regulations Bill, and the maintenance of the *status quo*. Some of the metropolitan vestries seem, at last, to be waking up and recognizing the fact that the Regulations Bill is not exactly calculated to do the best for gas consumers. Lambeth protests, and urges that if the South Metropolitan Company can supply 16-candle gas for 3s. 3d. per 1000 feet, and pay 10 per cent., it is, to say the least, unreasonable to give them the price of 3s. 9d. in order that they may make 12 or 13 per cent. Camberwell, we fancy, will follow in the same line of argument, and we must confess that we do not see what answer can be made

to the objectors, except this, "that Mr. Forster said that the "same initial price should be fixed for all companies." It may be taken as certain that Mr. Forster did not foresee the consequences of his decision, or, we feel certain, he would not have given it. The select committee next year will be required to give this point further consideration.

In connexion with this matter, a curious explanation was made at the last meeting of the Metropolitan Board. An evening contemporary asserted that the Lambeth members of the Board did not oppose the Bill of the Board. Well, the plain, simple, evident fact is, that they do not. It is a palpable mystification to say that one of them, last year, brought forward a motion to the effect that, if "any gas company had an income in excess of amounts "sufficient to pay 10 per cent., the surplus should go in diminu-"tion of standard price." The Bill, containing the provision which the Lambeth Vestry complain of, is to be reintroduced next session, and neither of the members said a word against it. What they said last year is nothing to the purpose. We do not, for a moment, suppose that either member will profit personally, if either the Regulations or the South Metropolitan Company's Bill should pass, but their constituents are quite right in taking care of themselves.

Mile End Old Town, Mr. Newton notwithstanding, will presently wake up, and a chorus of opposition to the Regulations Bill may be expected next year. So much the better for the chance of a Purchase Bill, if the Government make up their mind to promote one. The companies, we are sorry to say, have thrown away a grand opportunity. Our course is, however, perfectly clear. In the interest of shareholders, we stand up for present statutory rights, and nothing more. If the Government Bill give us annuities equal to maximum dividends, we shall be perfectly content.

Referring to a case reported in our last, we feel bound to say that the present is a very inopportune moment to press the claims of a gas company in a police court. If a company are so indiscreet as to let a man, not earning a pound a week, get £9 in their debt, for gas, and he declines to pay, they should cut off his supply, and say no more about it; laying, however, the lesson to their hearts, and being careful to secure a deposit, and never allowing a second quarter's rental to remain unpaid. The decision of Mr. Arnold clearly shows the special Acts now give companies no security, except in so far as they allow of the exaction of deposits. We have a very strong objection to harsh measures, but there is no charity in allowing a rogue to cheat even a gas company.

The London Gas Company are about to give notice that the price of their gas will be reduced to 3s. 6d., from the 1st of January next. We are afraid that the fact will be made use of by those in the Metropolitan Board who contend that the initial price, to be fixed by the Regulations Bill, should be lower than 3s. 9d. To our minds, the announcement is a proof that no Regulations Bill, with sliding scale, is necessary. It is clear that the gas companies are ready and willing to give consumers the full benefit of any diminution in the cost of production, without desiring more profit than the law at present grants them. If the directors of the London Company had been so minded, they might, at this conjuncture, with propriety have retained the present price, and not put a weapon into the hands of their enemies.

The Local Board of Dalton-in-Furness are anxious to make a compulsory purchase of the Dalton Gas Company, and the company strongly resist. Of course, it would be necessary for the Board to borrow money for the purchase, so a deputation waited on Mr. Sclater-Booth, to ask the sanction of the Local Government Board for a loan. On the same day the directors of the gas company waited on the President of the Board, in opposition. The allegation of the local authority is that the gas (cannel) is dear at 8s. 4d. per 1000 feet, and that the supply is inadequate. The company assert that they are willing to supply an abundance of gas at a cheap rate, and that the purchase of the works by the Board will involve an increase in local taxation. The report of the interviews, with which we are furnished, is obviously imperfect; but we gather that Mr. Sclater-Booth told the deputation that it was doubtful whether the gas company could be ousted, seeing that their Act of Parliament gave them alone, power to construct works and supply gas. In our opinion, it is certain that the company could not be "ousted." If Mr. Sclater-Booth will sanction a loan, the Board may set up competing works, which would prove a ruinous concern to them. Or they might go to Parliament with a Bill to effect a compulsory purchase, which would possibly be passed. The costs, however, would be heavy, and the result doubtful. Cannot the Board and the company make up their differences, and go on amicably together?

In order to complete the purchase of the gas-works, the Corporation of Belfast have borrowed of the Bank of England £220,000, which sum is to be repaid, in 20 years, by equal annual instalments. The rate of interest is 6 per cent., reducible to 4½ per cent., if paid within 21 days after due. It is said that the clear profit of the undertaking last year was £11,000, so it is certain that the Corporation have not made a bad bargain.

For the benefit of our Scottish friends, we may mention that in an action recently brought against a landlord in Dundee, for negligence in not providing the lighting of a common stair, it was decided by the sheriff that the only thing obligatory on the landlord was to provide permanent fittings for lighting the stair. It rests with the tenants to take gas or not, as they choose. The decision is not satisfactory to the Dundee Gas Commissioners, who imagined that their Act compelled all landlords to light a common stair.

## Water and Sanitary Notes.

An important announcement has been made by the New River Company. They have given notice that they do not intend to make any advance in their water-rates in consequence of the altered assessments. This is quite in accordance with the known liberality of the company, and, to some extent, cuts the ground from under the feet of the authorities, who are promoting a Bill to prevent the company from doing what they have obviously no wish to do.

An able report upon the accounts of the Lambeth and Southwark and Vauxhall Water Companies, and on the proposed legislation with respect to water supply, has been made to the Lambeth vestry, by Mr. William Storr. The writer is perfectly candid, and states fairly enough the case, both for and against the companies. After reading the report, we think most will agree, that there is but little to be said against the two companies named. It is nowhere alleged that they have exceeded their parliamentary powers, and the abstract of accounts furnished, proves, we think, that the undertakings have been economically managed. The charges of the Lambeth Company are differential rates, varying from 7½ per cent. for houses under the annual value of £20, to 5 per cent. for those over the value of £100, with additional charges for closets and baths. The Southwark and Vauxhall charge the uniform rate of 5 per cent. on houses of all values, with the usual additional charges for closets and baths. It is contended by the writer that the Lambeth scale is much the higher of the two, and that in the case of a £45 house, the difference between the charges of the companies is no less than £1 7s. We shall not follow out the calculation; but we may say that the uniform rate commends itself to us, inasmuch as its effect is to relieve the poorer classes, while doing no injustice to those who are better able to pay for water. The writer, however, seems to admit that the higher rate of the Lambeth Company is not enforced.

Strong objections are made to the supply of water for domestic consumption by meter, and, in the main, the author bases his objection on the belief we have already expressed—that the employment of the meter system would make people economical in the use of water. Many disadvantages would, no doubt, follow the restricted use of water, from some of which householders might immediately suffer, while it might necessitate a much larger expenditure, out of rates, for water to flush drains and sewers. This, however, is scarcely a valid argument against the meter system. People like to pay for what they consume, and, if it should be found necessary, a public rate might easily be imposed to pay for the water required for exclusively public purposes.

It is urged, with reason, that the cost of meters would add to the cost of water. No doubt it would, but then the extra charge would be compensated for by diminished consumption of water. The next section of the report may be disposed of with the remark that, if the meter system were in use, there would be no more disputes about annual value, water for gardens, closets, baths, or anything else. Water could be used for whatever purpose the consumer liked, with stint or without, according to his disposition. We are sorry to see that Mr. Storr adopts the conclusions and recommendations of the Rivers Pollution Commission. We differ from them almost *in toto*, but we cannot now enter upon the subject, nor can we to-day discuss the propositions suggested. With some we may express a qualified agreement, but we should certainly resist the proposed change of the sources of supply. The water now furnished to the metropolis we regard as admirable in quality, and not at all deficient in quantity. Any change would involve the waste of a large amount of money, without producing any commensurate advantage.

The Town Council of Dewsbury have just received a sort of "rap on the knuckles" from the Local Government Board. Some time ago, a section of the ratepayers complained of the insufficient sewerage of the district, and Colonel Cox was sent down to make an inquiry. He found sanitary matters in about as bad a state as they could possibly be, estimated by the usual

standards. Still it must be said that Dewsbury has not an extravagantly high death-rate. The Town Council, however, have done nothing to improve or complete the sewerage for four-and-twenty years, but they have recently busied themselves in providing other requirements for the borough, which they deemed of more importance—viz., water supply and gas-works. In his report, Colonel Cox points out, that the performance of one duty does not exonerate a local authority from the responsibility of performing another, and the Town Council are plainly told to set about making sewers.

We have before remarked on the growing desire, on the part of sanitarians and economists, to find a safe and easy method of collecting human excreta, in opposition to the wasteful and dangerous water-carriage system. At a meeting of the Royal Scottish Society of Arts, the other day, there was a long discussion on the Liernur system, which seemed to meet with the almost unanimous approval of the meeting. This reminds us to observe that we ought to have had, before now, a report of the commission sent to Holland by the Local Government Board, to investigate the working of the system in some Dutch cities. Mr. C. S. Read has left the Government; but this, of course, will not prevent him from giving his assistance in the preparation of the report, which ought to be issued as quickly as possible. Many local authorities are waiting to see it, before they move in sanitary matters.

## GAS AND WATER LEGISLATION IN 1875.

(*Continued from page* 868.)

The following Acts have been obtained by local authorities in relation to gas, and, in some cases, to combined gas and water undertakings.

The *Ashton-in-Makerfield Local Board Act* authorizes the Board to purchase the undertaking of the Ashton-in-Makerfield Gas Consumers Company, Limited. The consideration to be paid is a lump sum of £6928. Sixteen-candle gas is to be supplied, at a price not to exceed 6s. 8d. per 1000 feet. The Act also gives the Board power to construct and maintain water-works.

The *Barrow-in-Furness Corporation Act*, 1875, makes a further extension of the limits of the borough, authorizes the acquisition of land, the erection of new gas-works, an extension of the water-works, and confers the stringent powers now usually granted to Corporations with regard to sanitary and other matters. The Corporation obtain power to borrow a further sum of £60,000 for their gas undertaking, and an equal amount for water purposes.

The *Birmingham Corporation Gas Act* has been so fully referred to in our "Circular," that it is quite unnecessary here to recapitulate its provisions; the more so because the action taken by several of the outlying Local Boards of districts formerly supplied by the Birmingham and Staffordshire Company may presently necessitate further remarks.

The *Bradford Water-Works and Improvement Act* empowers the Corporation to expend, or rather borrow, a further sum of £200,000 for the acquisition of land, and the erection of new gas-works. For the future, 15-candle gas is to be supplied, and it is to be tested with an Argand burner, having 15 holes and a 7-inch chimney, and consuming 5 feet per hour. The Corporation also get power to borrow £300,000 for the extension of their water undertaking. The further provisions need not be noticed.

The *Hindley Local Board Act*—the preamble of which recites that, "whereas, by reason of the greatly increased cost of coals "and other materials used in the manufacture of gas, and of "workmen's wages and other labour, the rates at present levied "by the Board are insufficient to defray the expenses of their "gas-works"—authorizes the Board to charge a rate not exceeding 5s. per 1000 feet. It also empowers the Board to borrow a further sum of £30,000 for the extension of the gas-works.

The *Inverness Water and Gas Act* authorizes the Commissioners of Police of that Royal burgh to take over the combined undertaking of the gas and water company. The consideration is £153 for every £100 of share capital, and the payment of £5210, which the company have expended in excess of their share and mortgage capital. The transfer is to take place on the 1st of February next, and the commissioners are further to repay all that may be expended by the company on capital account up to that date, less £700, to cover defects in pipes and other plant. Stock is to be taken at a price, to be agreed upon or settled by arbitration. The manager and secretary of the company, who appears to have occupied the post for 22 years, is—whether his services be continued by the commissioners or not—to be compensated at such a rate as the directors of the company may think reasonable. Let us hope they will be liberal. The commissioners have to supply 20-candle gas, at a price not exceeding 8s. 4d. per 1000 feet. They may borrow a further sum of £40,000, in respect of the gas undertaking. The Act also gives power for an extension of the water undertaking, in respect of which the commissioners may borrow £41,000. The mortgages on the water-works, here called the "Funded Debt," are to be replaced by annuities, at a rate to be fixed by the commissioners.

The *Widnes Local Board Act* extends the gas and water limits of the Board, and authorizes additional works, and empowers the Board to borrow £30,000 for gas-works, and £70,000 for water-works. It is of no consequence to us, but as illustrating the fashion of the day, we may mention that £20,000 may be borrowed for the erection of a town-hall, which is something for Widnes. The price of gas in the extended limits is not to exceed 6s. per 1000 feet. As regard water supply, we notice that the water-works fund is indebted to the district rate to the amount of £4092 3s. 8d.; but it is not convenient to repay the amount, and the Act says that it need not be repaid. Local Boards will take notice

(*To be continued.*)

## A TREATISE ON THE SCIENCE AND PRACTICE OF THE MANUFACTURE AND DISTRIBUTION OF COAL GAS.

### LXXVI.

### Gasholders.

In our description of various gasholders, we have confined our observations generally to those existing in the metropolis; and as all the varied forms, dimensions, and methods of construction are there to be met with, a more extended search has been considered unnecessary. Among these structures we may mention one existing at the Kennington Lane station of the Phœnix Gas Company, which is represented by fig. 1, next page. That company, having purchased the site of the Kennington Lane Water-Works, in which there was a circular reservoir, with the walls sloping outwards, it was contemplated to build a tank within this, so as to utilize the existing building. Eventually a double-lift telescopic holder, of 147 feet in diameter, each lift of 18 feet 6 inches deep, was erected on the site, in 1847. This, we believe, was the largest telescopic holder existing at that epoch, and it is mentioned with the view of showing the gradual progress which has taken place in the magnitude of these vessels.

At the same station is another telescopic holder, a drawing of which is given, fig. 2, designed by the late Mr. Innes, of a diameter of 160 feet, and rising nearly 70 feet, with a capacity of about 1,250,000 cubic feet, which was constructed in 1854. The peculiarities of this holder consist in it being flat-roofed, without any trussing to support it; in the employment of cylindrical columns of wrought iron, the internal vertical stays of both holders being of timber; and, lastly, in the absence of girders to support the columns. As the specification of its construction possesses some points of interest, we give it almost *verbatim*:—

*Specification for a Telescopic Gasholder for the Phœnix Gaslight Company.*

Specification for the several works required to be done in providing and constructing a telescopic gasholder with wrought-iron columns, guides, column ties, with such quality and substance of wrought and cast iron as are herein particularly specified for the several parts, and agreeable to the drawing.

The whole to be supplied, erected, and completely finished for the Phœnix Gaslight Company, on their premises, at Kennington Lane, Lambeth, under the conditions and stipulations of a contract of which a copy is annexed to this specification.

The dimensions of the proposed gasholder to be as follows:—

*The Outer Lift.* The diameter of the outer lift over the extreme of the grip, and of the bottom tier of plates next the curb, to be 160 feet. The depth from the top of the grip to the bottom of the curb to be 35 feet. The grip to be 9 inches wide and 1 foot 3 inches deep.

*Inner Lift.* The diameter over the extreme of the top curb, and of the bottom tier of plates, to be 157 feet 9 inches. The depth from edge of top curb to the bottom of cup to be 35 feet. The cup to be 9 inches wide and 1 foot 3 inches deep. The crown to be flat, and without interior framing.

*Columns.* Of these there will be 16 to guide the holder, the height of each, from the top of stone base to the extreme of cap, all included, to be 73 feet. The diameter of the columns at the base to be 3 feet 3 inches, to be reduced to 3 feet 2 inches in the middle, and to 2 feet 8 inches diameter at the top. These will be made of wrought iron, in a series of cylinders of 6 feet long each. The two lower cylinders of the columns will be $\frac{3}{8}$ of an inch thick, and the remaining cylinders $\frac{1}{4}$ inch thick, all lap joints and snap rivets, $2\frac{1}{2}$ inches apart from centre to centre. The vertical joints running in a straight line to the full height, and the cross joints half lapping over each other.

The base of each column to have an angle iron 4 inches by 3 inches by $\frac{1}{2}$ inch, rivetted on the outside, and made perfectly true at the under-side, which is to face the cast-iron base-plates, and perforated with 16 13-16th inch holes at equal distances, leaving a space for the guide-rod, and to be secured to the cast-iron base-plates by $\frac{3}{4}$ inch bolts. The columns to be placed from centre to centre across the diameter of the tank, at a distance of 166 feet 9 inches, and around the circumference to be situated from centre to centre 32 feet 8 inches.

*Cast-Iron Base Plates.* Of these there will be 16, each 5 feet 6 inches long by 4 feet 9 inches wide and 2 inches thick, each provided with four holes for $2\frac{1}{2}$ inch holding-down bolts. A projecting flange, 4 inche wide and $1\frac{1}{2}$ inch thick, with 16 $\frac{3}{4}$ inch bolt-holes, corresponding with those in angle iron at the base of columns, to be cast therewith.

*Ornamental Castings.* There will be 16 ornamental castings, $\frac{1}{2}$ inch thick, for the base of the columns, and 16 beads of $\frac{3}{4}$ inch metal to be placed below the caps, and 16 of the same $\frac{1}{2}$ inch thick.

*Holding-down Bolts.* To have 64 wrought-iron holding-down bolts, each 16 feet long and $2\frac{1}{2}$ inches in diameter, to be screwed at the top, and provided with its corresponding nut. The lower end to be square, and having a cotter-hole, 3 inches by $\frac{3}{4}$ inch, and provided with a cotter.

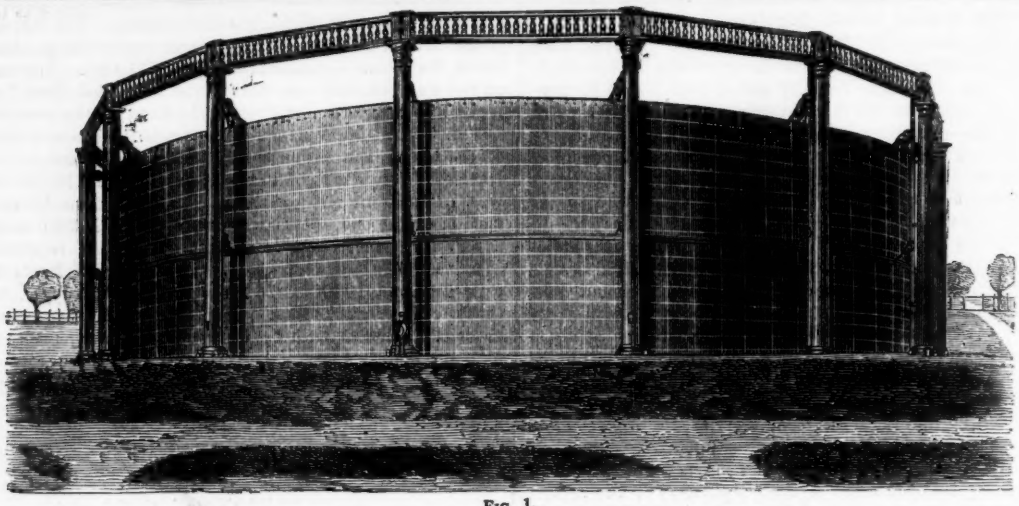

FIG. 1.

*Wrought-Iron Suspension Rods.* To have 64 wrought-iron suspension-rods, each 15 feet 6 inches long and 1¼ inch diameter for middle tie, and 64 wrought-iron rods, 15 feet 6 inches long and 2 inches diameter for top ties. The inner ends with bolts and nuts to fix in columns. The outer ends with square heads and cotter-holes and cotters.

*Cast-Iron Centre-Plates.* To have 32 cast-iron centre-plates for suspension ties, each 18 inches by 12 inches of 1 inch thick, with square sunk holes and cotter holes to secure the rods.

*Ornamental Shields.* To have 32 cast-iron ornamental shields, each 2 feet 6 inches by 1 foot 9 inches by ½ inch thick.

*Segment Pieces.* To have 128 cast-iron segment pieces for inside of columns and ends of suspension rods.

*Guides for Holder.* To have 16 T-shaped guides, each length, when complete, being 109 feet, made of 6 inch by 6 inch by 1¼ inch T-iron, trimmed and levelled on the face for rollers to work against, in lengths of 12 feet each.

*Cast-Iron Chairs.* To fix 336 cast-iron chairs to columns and tank-plates, 12 inches by 8 inches, by 1 inch jaws, to support the T guide-rods.

*Construction of Holders.* The bottom curb of the outer holder to be formed of cast iron, put together in segments of 12 feet in length, each half lapping the other, and bolted together with ⅞ in. bolts and nuts.

The top grip to be formed with two rings of 3 inch by 2½ inch by ½ inch angle iron, in lengths of about 1 foot 8 inches, with lapping pieces, each 3 feet long, of similar iron. The spaces between the angle iron rings to be of ⅜ inch plate, and 7 inches wide, in the longest possible lengths, and put together with lapping pieces rivetted on to the top. The dipping pieces to be formed of ¼ inch plate, strengthened at the bottom edge with two rings of 2 inches by ¼ inch half round iron, one of which is rivetted on the interior, and the other on the exterior.

*The Sheets of Holder.* The top and bottom rows of side plates adjoining the grip and the curb to be ¼ inch thick and 2 feet 6 inches wide. The next rows of plates to be ¼ inch thick and 2 feet wide from centre to centre of rivet holes. The two next tiers to be of No. 12 gauge, and all the remaining sheets to be of No. 16 gauge.

*Vertical Stays.* There will be 16 plates, each 2 feet wide and 3-16ths inch thick, placed vertically opposite each column, and put together in three lengths. In addition to this, 48 vertical stays of Memel timber, 6 inches by 3 inches, securely bolted to the top and bottom curbs, will be introduced to stiffen the sides, two of these being placed 4 feet apart from the plates already mentioned, and one in the centre between each pair of columns.

*Friction Rollers.* There will be 16 cast-iron friction rollers, with cast-iron carriages fixed on the outside of bottom curb, and working within the tank.

*Guide Rollers.* There will be 16 guide rollers, each 1 foot 6 inches in diameter, with projecting flange of 3 inches wide, fitted to their corresponding carriages, and attached to the top of grip, opposite to their respective guides, and 16 cast-iron guide rollers, each 3 feet in diameter, having flange 4 inches wide, with their jib carriages according to drawing.

*Inner Holder.* The cup of this to be formed of precisely the same description and substance of iron as the grip, and in a similar manner.

*Top Curb.* The top curb to be made of angle iron, 6 inches by 3½ inches by ⅝ inch, put together with lapping pieces 3 feet long. On the top of this curb is to be rivetted a ring of boiler plate, extending around the holders, 1 foot 9 inches wide, and ⅝ inch thick, but at the points opposite the columns, the width of these will be increased to 3 feet 9 inches, in order to receive the dead plates of the carriages.

*The Crown of Holder.* The first row of crown sheets next the ⅝ inch plates to be 2 feet wide and ¼ inch thick. All the rest of the sheets to be No. 12 gauge.

*Sides of Holder.* The sides to be formed of 17 tiers, similar to the outer vessel; the top and bottom tiers to be ¼ inch thick, and of the same width as those in the outer vessel. The two next tiers to be 3-16ths inch thick, and the remaining tiers to be of No. 12 gauge, the whole of the plates being 2 feet wide from centre to centre of rivets.

*Vertical Plates.* To have 16 vertical plates, each 2 feet wide and ¼ inch thick, to be introduced in the sides, opposite each column.

*Vertical Stays.* To have 32 vertical stays, composed of Memel timber, 12 inches by 3 inches, placed on edge, and bolted to an angle iron at each side of 4 inches by 3 inches by ½ inch; the angle iron being bolted to the side plates, as also to the top curb and bottom angle iron. Of these, 16 stays are to be placed opposite each column, and the others at intermediate distances. There will be also 16 intermediate stays, also of Memel timber, but of smaller section—viz., 9 inches by 3 inches.

*Gusset Stays.* Attached to each side of the main vertical stays there will be a gusset stay, 3 feet in length, and formed of 3 inches by 3 inches by ½ inch, extending from the angle iron, filled in with ¼ inch plate.

*Man-hole.* A man-hole to be formed in the top of holder, 5 feet diameter in the clear and 6 inches high, the rim to be formed of 2½ inches by ⅜ inch angle iron, and ¼ inch plate. The top to be ¼ inch plate with ½ inch bolt-holes, 3 inches apart from centre to centre, the joint to be made with hempen cord and a mixture of white and red lead.

*Rivetting.* When rivetting the sheets, a strand of cord is to be placed within the joints. The ⅜ inch rivets to be made red hot before being hammered.

All the plates to be thoroughly free from flaws or defects of imperfect rolling, and to be carefully hammered and levelled, so as to appear perfectly uniform throughout, and to be thoroughly coated with raw linseed oil. All defective plates may be rejected.

The joining and lapping of the plates and other wrought-iron work to have a good coating of red lead and oil, laid on before being joined. The whole of the gasholder, both inside and outside, to have two good coatings of red lead, mixed with equal quantities of linseed oil boiled, carefully laid on.

The gasholder to be proved with air, driven in by an exhauster, and carefully raised and lowered several times, and all defects thoroughly examined and perfectly rectified before the gas is introduced.

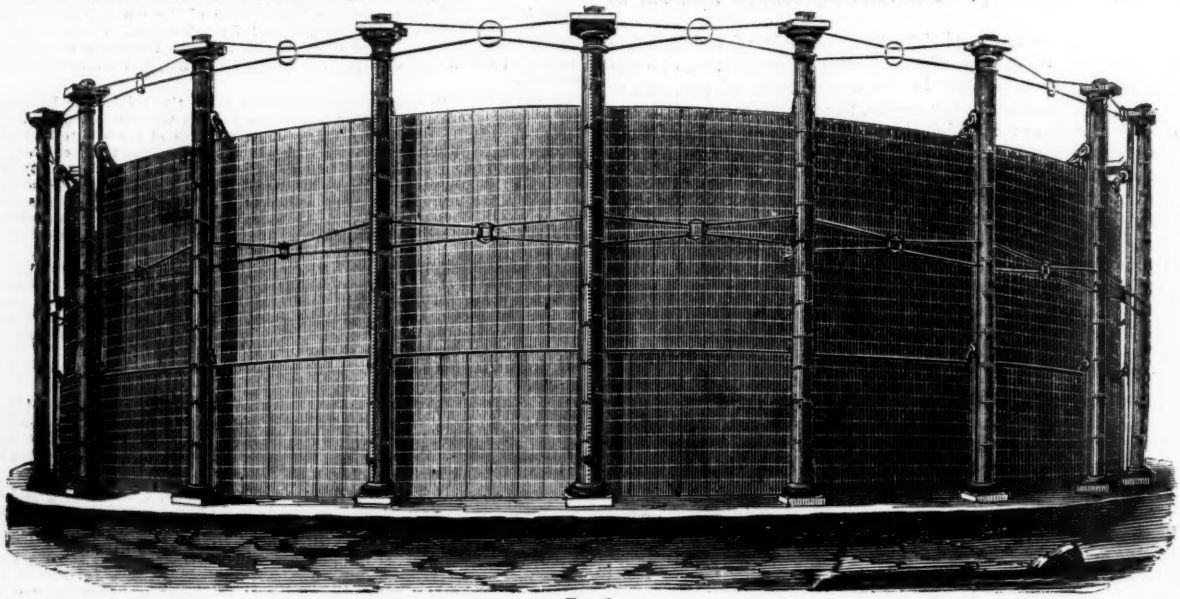

FIG. 2.

We had occasion to refer to this holder in our last, and to the opinion concerning it expressed by Mr. C. Woodall, who has had ample opportunity of judging of its merits and defects. It may be added that, according to the statement of that gentleman, the framing, from its light and pliable nature, sways before a strong wind. That would be dangerous if the holder had a heavy crown, but, as it is, he has every confidence; though the absence of girders is considered by him a decided error.

The site of the gas-works, until recently occupied by the City of London Company, possesses considerable interest, on account of it being the locality where the first English opera-house was erected, in the reign of Charles II., having an entrance facing the Thames, which, at that period, was a common highway for the citizens of London.

The site afterwards became the property of the New River Company, whereon they established a wharf for the loading and storeage of elm trees, and extensive workshops for the manufacture of the wooden pipes which served to distribute the supply of water throughout a large portion of the metropolis as it then existed. These pipes were formed of the trunks referred to, left on the exterior in their rough state, and bored from 3 inches to 12 inches in diameter, according to the diameter of the timber.

At the commencement of the present century, cast-iron pipes were employed to supersede the old wooden pipes, and about 1810 the use of the latter was abandoned altogether, when the wharf and workshops at Blackfriars were no longer required by the New River Company. In 1815 the premises were taken by the City of London Gaslight and Coke Company, who transferred their works thither from Fetter Lane; and, although the site appeared, at that period, sufficient for the requirements of their business for all time, it was found in the course of years, as gas lighting advanced, that augmentations had to be made to the works, rendering the addition of further land necessary. This eventually had to be acquired at enormous—almost fabulous— cost, and the exigencies of the locality and circumstances rendered the application of all the scientific skill in the construction of gasholders, and other apparatus and plant, indispensable.

It may be stated that the City of London Company was, during several years, the most advanced in constructing holders of magnitude, and, according to the report of Sir William Congreve, the Government inspector of gas-works in 1822, it appears that whilst other companies were erecting holders of the capacity of 10,000 cubic feet, at the Blackfriars works there existed a holder or "gasometer of the enormous capacity of 40,000 cubic feet." Again, in 1844, Mr. John Gaines being the engineer, this company constructed an iron tank, with a two-lift gasholder of 100 feet in diameter, each lift being 22 feet 6 inches deep, and guided by twelve columns, and one tier of cast-iron trussed girders. This, in all probability, was the largest holder in existence at that date. Another remarkable achievement at the same works was the construction of the three-lift holder, erected by Messrs. Westwood and Wrights, in 1861, under the direction of the engineer, Mr. William Mann. A description of this holder we now proceed to give, referring our readers, at the same time, to the page engraving presented with the present number, which is intended to form a frontispiece to vol. xxvi. of the JOURNAL.

The necessity for a holder of this description arose from the force of circumstances. It was originally intended to build a two-lift holder, each lift being 50 feet deep, on the ground now occupied by the three-lift holder in question. With this object in view, a trial shaft was sunk, about 220 feet from the river wall, which shaft, in addition to serving to ascertain the nature of the ground, was also intended for the dry well containing the inlet and outlet pipes of the holder. But, in sinking to a depth approaching 40 feet, the nature of the ground was found to be so treacherous, and the accumulation of water so vast, as to cause the idea of excavating to the depth first contemplated to be abandoned. During the excavation a large quantity of ancient brickwork was discovered, as well as chains and other indications of moorings for river craft, which strongly favoured the view that this was an old embankment wall; and, as the "River of Wells" had its mouth at this same locality, it is probable that this wall was at the entrance to that river.

In the course of operations, a careful investigation of the locality having been made, it was ascertained that an excavation might be attempted that would admit of a cast-iron tank of 84 feet in diameter and 33 feet deep, with an annular space of 3 feet 6 inches in the clear, for the reception of the holder. This excavation, although of comparatively small diameter and depth, was attended with many and serious difficulties, on account of the site being surrounded by high buildings, the foundations of which would be exposed in the course of the undertaking, and which, in some instances, were considerably above it.

Another source of danger was the close proximity to other holders, which could not possibly be put out of action without prejudicing the lighting of a large portion of the City; and, moreover, increased storeage for gas was imperatively demanded, in order to carry on the operations of the company in a successful manner.

Under these critical circumstances, the utmost caution and skill were indispensable, in deciding on the best manner of carrying the undertaking to a successful issue; and, after due deliberation, it was resolved to construct an annular tank of the dimensions stated, for which the necessary drawings were accordingly prepared.

The tank, however, being only 33 feet instead of 50 feet, as first intended, it became necessary to resort to special means, in order to attain the desired capacity of the holder as at first suggested; and, for this purpose, it was proposed to make the holder with three lifts; but as the attempts to make such vessels had generally resulted in failure, even when their heights were considerably less than in the construction proposed, a doubt existed as to its practicability and safety.

Messrs. Westwood and Wrights, who had erected the 100-feet holder in 1844, before mentioned, as well as others, were then consulted on the subject, and those gentlemen expressed their willingness to undertake the construction of a three-lift holder and tank, together with the excavation, with all the responsibility and risk attending its erection, and to ensure its satisfactory working. The difficulties of the undertaking will be realized when it is stated that the site was less than 100 feet square, and surrounded on all sides with high buildings and gasholders. The necessary contract was then made, and in due time the work executed without the slightest accident.

A particular feature in the design was that all the flanges and connexions should be placed within the annulus, and so arranged that, in the event of any part or piece being damaged during the construction, it could be removed and replaced without disturbing the others. This was a point of the utmost importance, as, from the confined limits of the locality, it was impossible to get at the outside of the tank. Another point of difficulty in the erection was the large quantity of timber shoring necessary to sustain the earth and surrounding buildings, which interfered with the progress of the work, and required to be removed with great care. The excavation made, and the base or foundation concreted, the first tier of the plates of the side was placed, bolted, and cemented; the exterior was then immediately backed up with concrete. This ring completed, the second was in like manner erected, and backed with concrete as before, and so on to the top. In the meantime the utmost caution was observed to avoid injury to the surrounding buildings—by no means an enviable task, with the foundations of high houses many feet above the work, where every little slip of earth gives rise to distrust and doubt, and is often the timely warning of a coming calamity. It is a matter of astonishment, and a source of great congratulation, nevertheless, that so very few accidents arise in the execution of work attended with the danger which must have accompanied that in question.

We may here mention that often large double-lift telescopic gasholders only rise to a third of their diameter, and in but a few instances are they made to rise a height equal to one-half of their diameter. In one instance that we have mentioned, a three-lift holder was constructed which merely rose to a third of its diameter. It must, moreover, be remembered that the liability to disarrangement by the action of the wind, when the holder is exposed to a strong gale, is augmented in direct proportion to the height, in consequence of the increased leverage, if such a term may be applied.

In the three-lift holder now under consideration, which rises to more than double the height of telescopic holders (in proportion to their diameter), as usually built, the question of determining a suitable framing for supporting it, without any superfluous material entering into its formation, was one that required the exercise of sound judgment, and this, together with the execution of the same, reflects the highest credit on the manufacturers.

The tank, as already stated, is 84 feet in diameter, and 33 feet deep. The lowest lift of the holder is 82 feet, the second 80 feet, and the third lift 78 feet respectively in diameter. The holder rises to a height of 98 feet, being about one-fifth more than its diameter.

The guide-framing consists of twelve columns, each 108 feet high, 2 feet 6 inches diameter at the base, and 1 foot 2 inches at the top, the entablature and cornice being comprised in the measurement. Each column carries a guide-rail of cast iron, in one unbroken line of surface, from the bottom of the tank to the upper part of the cornice. These guides are machine-planed from end to end, and when in their places were rigidly fixed in a vertical position to the columns, and within the tank.

The columns are stayed to each other by three tiers of wrought-iron lattice-work girders, binding them together around their circumference. In order to prevent the columns from sustaining any outward strain, there are three wrought-iron lattice girders affixed to three of them, almost in a horizontal position, which girders converge to the centre, where they are united—an important part of the framing, as it binds all the columns together. On the columns which carry the converging girders are placed the pulleys, over which pass the chains, to which are suspended the counterbalance weights.

Upon the outer ends of the triple girder arrangement are receptacles fitted with carriages and pulleys, forming three sets of triangular suspension gear, one set being employed as counterweights to each lift. The diagonal tie rods, meeting in a ring in the centre of each interval between the columns and girders, are bolted to lugs cast on the bottom and top of the shaft of each column. This arrangement has been found to give the structure great stability.

The extra counter-weights on the lower lift were not a part of the original design, but were added subsequently, the pulley carriages being fixed to the lower tier of girders. The upper gasholder has a light framing, and means were employed to strengthen the top by attaching the sheets at many points, by a special arrangement, to the bars forming the framework.

The hydraulic joints, or cups, are so constructed as to give access to the internal working parts, without removing the inner or outer lifts from the tank. This structure was a complete success, and its durability has been established by the fact of its having been at work continuously up to the present time, without either repairs or attention, beyond lubricating the bearings; and, although exposed on the south side to occasional severe gales, the holder and framing have never shown any signs of weakness.

The ironwork was manufactured and erected, as we have stated by Messrs. Westwood and Wrights, the excavation and foundations

by Messrs. John Aird and Sons, the engineer being Mr. William Mann.

In 1868 The Gaslight and Coke Company obtained an Act authorizing the erection of extensive works at Beckton, and, under the powers of the same Act, they shortly afterwards amalgamated the undertaking of the City of London Gas Company. Since the completion of the Beckton works, the manufacture of gas at the Blackfriars station has been discontinued, and in the spring of this year the site was sold to the Corporation of London (who were the freeholders of a portion of the land) for the sum of £170,000, the company retaining only a small part for the erection of a valve-house. The works are now in course of being dismantled, but the holder represented in our engraving, which was photographed during the process of demolition, still exists amongst the ruins, and is well worthy the inspection of all interested in gas matters before it disappears, and perhaps for ever.

(*To be continued.*)

## Correspondence.

### APPARATUS FOR EXTRACTING SULPHUR FROM SPENT OXIDE.

SIR,—Referring to Mr. Addenbrooke's letter, in your issue of the 14th inst., I did not gather from Mr. Wood's address, as reported in your JOURNAL, that he claimed the apparatus for extracting sulphur from spent oxide as his own, it being, in fact, one of many supplied by this company to numbers of managers throughout the kingdom.

The value of bisulphide of carbon as the best solvent for sulphur has been known to chemists for many years; but if there be any merit in the particular form of apparatus shown by Mr. Wood, it may be fairly claimed for Mr. Stephenson, the chemist connected with this company.

With reference to Mr. Addenbrooke's suggested improvements, I enclose you one of the sheets of instruction that we issue with the apparatus, from which you will perceive that the use of the water-bath is recommended in preference to the naked flame. A Liebig's condenser can be used with advantage; but the vertical form is preferable, as the most convenient for packing.

I take this opportunity to say that we shall be happy to supply an apparatus, free of charge, to any manager not already possessed of one, together with the necessary instructions for use.

JOHN W. O'NEILL, Managing Director.

*Gas Purification and Chemical Company, Limited,*
*Palmerston Buildings, London, Dec.* 16, 1875.

### STEAM-JET GAS-EXHAUSTERS.

SIR,—I have read with lively interest Mr. Young's letter in your last number. It well deserves a reply from me, as far as it relates to the steam-jet exhauster.

Mr. Young reminds your readers that he questions the validity of my patent for exhausting and scrubbing by a jet of steam. All I shall say on this point is, that I was well advised, before protecting the invention, that the patent would be valid, and nothing which has come to my knowledge since has shaken my confidence in the soundness of that advice.

I could, if I chose, respond to Mr. Young and others by an imposing array of figures, with elaborate descriptions, and satisfy them that, at all events, I am not the dupe of hazy ideas, in "simply asserting" the advantages of the steam-jet. But, *cui bono?* There is much advantage in supporting assertion by figures derived from independent and accredited sources; but what magic is there in figures, that they should obtain credence, where the emphatic and repeated "assertions" of the same writer are received with doubt? My figures and descriptions might, indeed, furnish material for a paper war: but I shrink from the inkshed of such a campaign, as you, Mr. Editor, might well shrink from its huge occupation of your columns. Besides, the steam-jet exhauster and scrubber are now fairly launched, and their real value will soon be known, however quiet or restless the writer may be.

My thanks and those of Messrs. Körting Brothers are due to Mr. Young for his hearty approbation of the Körting-Cleland exhauster. The multiple arrangement of "cones" for gas-exhausters originated with myself, but Mr. Ernst Körting added very greatly to its practical value by his ingenious and compact contrivance of a sliding cylinder for closing and opening the gas ports. This, in effect, converts the apparatus into a box, packed with any reasonable number of gas-exhausters, of various capacities, so arranged that the exhauster in action can be thrown out, and the one of the capacity required, for the time brought into action in a few seconds, by the turning of a single screw, and without the slightest interruption to the exhaust.

We have also to thank Mr. Young for his information as to regulating the steam by a needle in the orifice of the jet, although it is not new to us, that improvement having been included in my original patent, and itself subsequently improved. There are differences of opinion as to the practical convenience and value of that arrangement, but Mr. Young's opinion is undoubtedly sound, that the point of first contact between the gas and steam is the point where the latter must be regulated, if we would fully utilize its expansive force. But one does not require to be long conversant with the steam-jet exhauster before he finds it to be so elastic and accommodating that *à priori* reasonings, derived mostly from the steam-engine, as to waste and economy of steam, are falsified to a surprising degree by practice. The surprise arises from overlooking the comparatively small resistance to be overcome. This, even at 24 inches of water, is less than 1 lb. per square inch. Hence the steam may be "wiredrawn" to an unusual extent before quite losing its exhaustive power.

Mr. Young points to possible improvements, some of which are now passing through the Patent Office, when he speaks of enlarging and contracting the passages for the gas, more "especially when the gas is, from time to time, variable in the back pressure and in quantity." How to make this expansion and contraction automatic, without complications that would seriously detract from the unique simplicity of the apparatus is a problem often pondered. Would that it could be done by such a simple thing as "a slide fixed to the same lever which actuates the jet needle." A little reflection will show Mr. Young that it is no such easy matter. For increasing resistance proceeding from the gasholder side of the exhauster, contraction of the gas passages is a desideratum; while increasing resistance arising from increasing production calls for expansion of those passages. Conversely, reduced resistance, as from opening a lighter gasholder, while other things remain the same, calls for expansion; while reduced resistance from reduced production demands contraction. These directly opposite effects cannot be caused by the same movement of the same lever.

However, that men of Mr. Young's special knowledge now throw out, not cold water, but shrewd suggestions for the improvement of the apparatus, may be accepted as an auspicious omen by all who wish for its success. Meanwhile, it is but fair to bear in mind that, although automatic expansion and contraction of the gas passages are necessary to perfection, the absence of these is not specially characteristic of the steam-jet exhauster, which, even as now constructed, with all imperfections, real or supposed, will more than bear comparison with any other.

As this letter has already exceeded its intended limits, I must postpone a few remarks on the subject of exhausters in general, in which I shall endeavour to point out where, in an argument otherwise clear and interesting, the fallacy lies by which Mr. Dunlop and others seem to have been led to some astounding opinions, recently uttered, as to the trifling utility of exhaustion.

WM. CLELAND.

*Linacre, Dec.* 11, 1875.

### GAS-EXHAUSTERS AND THE DEPOSIT OF CARBON IN RETORTS.

SIR,—I quite expected Mr. Anderson to kick at my suggestion anent his studying Boyle's laws, but was scarcely prepared for him striking out so wildly, repudiating, as he does, all necessity for so doing—not because he is already thoroughly conversant with them, but because he had studied and observed Nature's laws, and was quite content with so doing; and as he requires no rule to guide him, I, therefore, conclude that he works by rule of thumb, or otherwise he must have reasoned out these laws in "the laboratory of his own soul." Possibly it may be this inclination to study nature which has prevented him from studying, or, at least, from apprehending, the true meaning and drift of what he styles "Dunlop on the laws relating to the distillation of gas under varying atmospheric pressures."

Be the cause, however, what it may, there is no doubt that there is something inducing Mr. A. to believe that those laws of nature (not mine) relate to the influence of atmospheric pressure on coal gas *after it has been produced*, whereas they relate to pressure—atmospheric and working—on the coal inside the retort, and *during the destructive distillation for the production of gas*, and only in so far as it affects the yield per ton and illuminating power of the gas, the deposition of carbon, and the choking of stand-pipes. He appears to overlook the fact that I have all along admitted the utility of the exhausters in overcoming the working pressure, and thereby lessening leakage through the pores of the retorts, although I am not inclined to admit that the gain is at all commensurate with the expense, if this is all that exhausters effect on the production of gas.

I am most anxious to obtain information and the opinions of others on this subject, not only because, as put by Mr. A., I wish my views approved of, for I would be quite as well pleased to have them condemned, provided that a good reason be assigned for their condemnation.

I regret that I gave Mr. Anderson any cause to complain in not furnishing him with the substance of his misquotation, and twisting the inference and the meaning of my former letter. Since he has not thought it necessary to look the letter up, I think it scarcely necessary to refer to it either, more especially since in his last he repeats the substance of his previous misquotation. He says Mr. Dunlop stated that at Lanark (800 feet above the sea) they work with *more advantage* without an exhauster than at Glasgow (800 feet lower) with one. Substitute "less pressure on the coal during distillation" for "more advantage," and you have the true meaning of the passage quoted—a meaning very different indeed from that given to it by Mr. Anderson.

What I wish Mr. Anderson to inform me is, does this less pressure influence the nature of the destructive distillation—or, in other words, does a ton of coal, when distilled under pressures of, say, equal to respectively 27 inches and 31 inches of mercury, give the same quality and the same quantity of gas, the gases from both charges being tested at the same pressure and temperature? Further, does the pressure on the charge of coal, during distillation in the retort, influence the choking of the stand-pipes, and the amount of carbon deposited inside the retort?

The latter query Mr. A. answers both in the affirmative and negative. He first says that 10 per cent. more gas is often obtained, not from gas which would have been *pressed* into carbon, but from gas which would have leaked; then he admits that less carbon will be produced in a retort under exhaustion, but, at the same time, he does not admit that the *pressure* of an exhauster is a remedy—it only ameliorates. I am really at a loss to get at his true meaning. If the extra yield of gas is not partly from the deposition of the volatile carbon, where does the carbon go to, which is prevented from being deposited by the *pressure* of the exhauster? He surely does not mean that the *pressure* of a retort under exhaustion presses the air through the pores of the retort, and that the carbon is thus removed in the form of carbonic oxide and carbonic acid, and that thus the gas is increased 10 per cent. in volume.

I do not expect Mr. Anderson to condescend further in his efforts to dispel the fogs which, as he asserts, have arisen from the false philosophy advanced by me; but I have yet hopes that a brighter and a stronger sun shall arise to do so. Should Mr. Anderson, however, after further consulting Nature's laws, favour us with replies to the queries contained in this letter, I am sure we shall all feel grateful.

WILLIAM DUNLOP.

*Corporation Gas-Works, Hamilton, Dec.* 9, 1875.

### THE DEPOSIT OF CARBON IN RETORTS.

SIR,—I read Mr. Tysoe's letter on this subject with much interest and pleasure, but was soon led to the conclusion that dialysis does not present an adequate solution of the problem. I have seen cases where carbon has formed almost as rapidly in cast iron as in clay retorts, and if its presence is to be explained by dialysis, we must assume that the action takes place through cast iron combined with a considerable thickness of the deposit itself.

By breaking a piece in my hand, I observe it has been formed in layers, and as this is so in both clay and iron retorts, I may venture the opinion that the deposit is due mainly to the decomposition of hydrocarbon gases upon highly-heated surfaces, and that if you have a minimum temperature, you have a minimum deposit.

That pressure promotes the decomposition of hydrocarbons is, I think, clearly established, and it would be interesting to determine how far dialysis should be taken into account.

C. TAYLOR.

*Derby, Dec.* 18, 1875.

## PURIFICATION OF GAS IN CLOSED VESSELS.

(*Continued from page* 830.)

SIR,—If you take ammoniacal liquor from the hydraulic main, which may be of about 3 to 4 ounce strength, and pass crude gas through it sufficiently long, you may raise it to 20 or 30 ounce strength.

Hydraulic-main liquor of 2½ ounce strength I have found to contain 400 cubic inches of $CO_2$ and $SH_2$; and when worked up to only 14½ ounce strength, it has contained 5000 inches of those impurities.

Ammoniacal liquor is, therefore, a purifier of crude gas. This we all admit; but the quantity of $CO_2$ in the coal being greater than either the ammonia or the $SH_2$, the liquor gets carbonated, and becomes inert before the gas is sufficiently purified; hence the liquor (even with the addition of a considerable quantity of pure water, which is also a purifier of crude gas) is of itself insufficient; but if we can cheaply remove both $CO_2$ and $SH_2$ from the now fouled liquor, we will give the liquor new life, and power to resume and complete its unfinished work. If you pass crude gas, from the outlet of the condenser, through caustic ammonia, you can rid it of every trace of $SH_2$.

That $CO_2$ can also be removed by the same agent, is, no doubt, equally true, for this is one of the questions I take for granted, "Will an acid and an alkali combine?"

If the foregoing reasoning, then, be true, we may, by a proper use of the ammonia contained in the coal, remove all impurities from the gas.

This brings me to what is the proper way to employ the ammonia, for a very trifling error here will destroy the whole process.

First, then, the condensation having been performed, pass the crude gas into a vessel charged with the weak liquor of the previous processes, and I do not care how weak it is—the weaker the better.

The result produced in this vessel is to strengthen the liquor up to 14 to 16 ounces, when it may be either sold or treated for decarbonating, as shall be described, and in so doing, we have removed from the gas a very considerable quantity of carbonic acid, sulphuretted hydrogen, and ammonia.

Next, pass the partly purified gas into another vessel charged with pure ammonia—*i.e.*, gas liquor from which carbonic acid and sulphuretted hydrogen have been removed, and this vessel (or vessels) *must* be capable of extracting the whole of the carbonic acid, and the gas issuing forth must be tested for this impurity.

The gas, now freed from carbonic acid, is next to be passed through a vessel charged with pure ammonia, which it will sulphuret or convert into what the chemists call sulphide of ammonium, in which state it is found capable of extracting those fixed compounds of sulphur which are not distinguishable by the ordinary test-papers.

From this last vessel the gas must pass into another vessel, also charged with pure ammonia, but this time only to extract the remaining sulphuretted hydrogen; and, lastly, it must be passed into a vessel charged with pure water, to remove the whole of the ammonia, when the gas will be purified.

In practice, it will, no doubt, be found convenient to run the contents of a later vessel into an earlier one.

For instance, vessels containing merely weak ammonia as the last, or merely sulphuretted liquor as the one next to it, may be run into vessels Nos. 1 or 2; but the extent to which this can be done will depend upon how far they can bear it without injuriously interfering with the chemical conditions to be maintained, as before described, and no doubt different qualities of coal will differently affect this.

I make these last observations because I think I have seen it somewhere stated that the sulphur compounds known as bisulphide of carbon, once removed, become fixed in the material with which they have combined. If this is so, the contents of all the vessels might change, as used to be done in wet lime purification, but I am inclined to think that this cannot be so, and I would hesitate to run a vessel charged with bisulphide of carbon into one in which I desired to fix the more active acid, $CO_2$, for I would be afraid that it might liberate sulphur in every form, and not only such forms as could be afterwards removed.

Before leaving this part of the subject, I desire to state that I have not made experiments that will bear me out in all the statements I have made. In some instances I have not, but where I have not I have accepted the statements of chemists—as to the combinations that will be formed, when these have agreed with, or did not contradict, what I already knew on the subject.

The next question that arises is, how are we to purify our liquor for use, over and it may be several times, over again?

The chemistry of how it can be done is very simple; but how it is best to be done is not so simple—how it is to be done cheaply and readily in large quantity, and not increase the cost of gas.

Mr. Livesey told us at Leeds that he was using liquor purified by a process invented by Mr. Hills, of Deptford, and he gave a very good account of the results he obtained by the use of it in his scrubbers. This was by the application of heat. If the process is effectual, we can get that heat either from the hot furnace gases before they enter the chimney, or from breeze, which is now, in many places, an unsaleable drug.

Should this process not produce the liquor sufficiently pure, perhaps it is within the domain of known chemistry to teach us some practical method of separating the carbonic acid and sulphuretted hydrogen, while, at the same time, giving us the ammonia to act on the gas.

It often happens in a country that there is plenty of knowledge, and also plenty of wants; but, for lack of the knowledge and the wants being brought together, things remain as they are. I now bring a want to the minds of those chemists who apply themselves to gas affairs; it is for them to supply a remedy.

I have now—in an imperfect manner, I know—given my views as to how gas may be purified in closed vessels. The time at my command has been quite insufficient to enable me to deal so fully with the matter as I feel it deserves.

If gas can be purified as I have described, and the noxious ingredients, all save carbonic acid, fixed in substances in which they create no nuisance to our neighbours, and from which they can be separated, and made both useful and profitable, it is worth a trial.

If gas can be purified by a liquid process, and the different altitudes of the vessels so arranged, that much may be done by gravitation, and the remainder by pumps, worked by our steam-engines, I feel that there is every probability that the process will be cheapened; and I also believe that such vessels may be provided at much less expense, and occupy much less space, than those now in use for lime and oxide.

On the other hand, the process I have decribed may be useful to supplement the present system of purification; for instance, the present washers or scrubbers may be retained to act as vessels Nos. 1 and 4, and the present purifiers, whether for lime or oxide, may act in lieu of vessel No. 3., leaving only No. 2 vessel to extract the bisulphide of carbon, as sulphide of ammonium will do this with less smell than the sulphide of calcium can.

I thank you for the space you have permitted me to occupy, and trust that men of experience and leisure may be induced to consider the matter, and give us the benefit of their investigations.

*London, Dec.* 16, 1875. GEORGE ANDERSON.

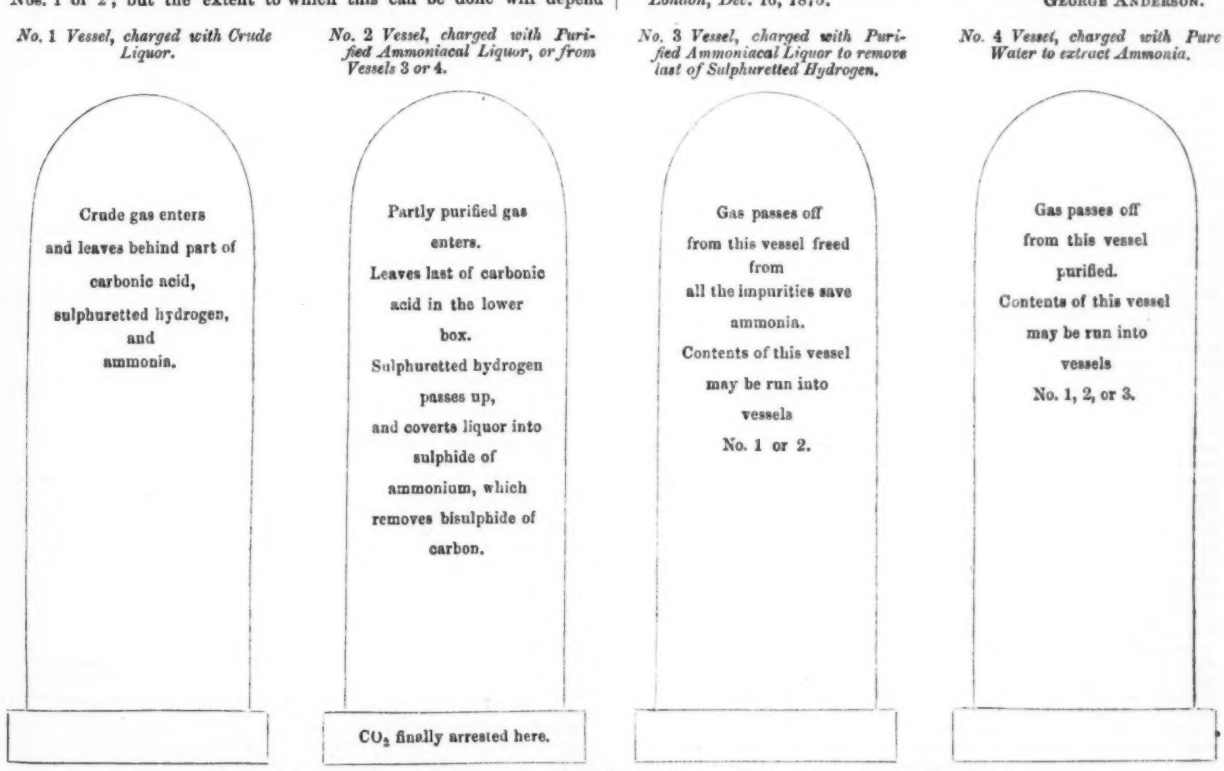
No. 1 Vessel, charged with Crude Liquor.
No. 2 Vessel, charged with Purified Ammoniacal Liquor, or from Vessels 3 or 4.
No. 3 Vessel, charged with Purified Ammoniacal Liquor to remove last of Sulphuretted Hydrogen.
No. 4 Vessel, charged with Pure Water to extract Ammonia.
Crude gas enters and leaves behind part of carbonic acid, sulphuretted hydrogen, and ammonia.
Partly purified gas enters. Leaves last of carbonic acid in the lower box. Sulphuretted hydrogen passes up, and coverts liquor into sulphide of ammonium, which removes bisulphide of carbon.
Gas passes off from this vessel freed from all the impurities save ammonia. Contents of this vessel may be run into vessels No. 1 or 2.
Gas passes off from this vessel purified. Contents of this vessel may be run into vessels No. 1, 2, or 3.
CO2 finally arrested here.

DIAGRAM OF THE VESSELS REFERRED TO. (THE GAS PASSES IN THE SUCCESSION OF THE NUMBERS.)

# Legal Intelligence.

## HIGH COURT OF JUSTICE—CHANCERY DIVISION.

FRIDAY, DEC. 10.

(*Before Vice-Chancellor* BACON.)

PATTERSON *v.* THE GASLIGHT AND COKE COMPANY.

Mr. KAY, in resuming his argument this morning, said that in answer to the invitation sent to Dr. Odling to inspect the Beckton works, that gentleman replied that he should be very glad to help the company in the difficulty in which they were placed, but the control of the amount of sulphur in gas was a matter on which certain trustworthy knowledge was but very small; however, he would, at any rate, do his best. That was a perfectly true statement as to the state of knowledge of the subject on the 19th of February, 1872. If he was right in saying that, the difficulty had been practically solved by the invention of Mr. Patterson, how could any one say, taking that letter as evidence of the state of knowledge at that time, that a patent dated the 9th of March of the same year was not a new invention? Dr. Odling visited the Beckton works on the 24th of February, and reported that he felt some difficulty in reporting on the subject, on account of the very small amount of positive knowledge which existed as to the conditions under which crude gas became charged with sulphur, as to the form or forms of combination in which the sulphur occurred in the gas, and as to the means by which it was capable of removal therefrom. In a letter of the 19th of February, Trewby stated that he had been working the lime purifiers in a somewhat different manner—viz., by keeping certain purifiers for the purpose of taking out the carbonic acid only, and the remainder of the purifiers for the sulphur; and in his evidence he stated that, after working the purifiers in such manner, he found that no improvement was effected. So that down to the 29th no improvement had been effected. He went on to say that on the 29th he put a small glass purifier to work, filled with foul lime, and by the 1st of March it had greatly reduced the quantity of sulphur, and by the 20th had brought it down to 7·24; so that, in his affidavit, Mr. Trewby stated that down to the 20th of March he was not satisfied, and could not make any change, or effect any improvement on a manufacturing scale, though he could effect improvements in the laboratory experiments; and, therefore, he felt something must be wrong in the works, some deficient action in the purifiers which, hitherto, he had not suspected. He discovered that in some cases the lime came out of the purifiers in the same state in which it went in, the gas not having passed through it, and, on examination, he found that the purifiers constructed of wrought iron had become more or less distorted, by reason of which the gas passed through the trays and did not come in contact with the lime. This defect having been remedied, an improvement took place; but it was not until the third set of purifiers were charged with lime that the sulphur came down to its lowest limit; so that the experiment suggested by Mr. Patterson, on the 15th of February, of taking out the carbonic acid first, and then trying the action of lime having been tried on the 18th, it proved an utter failure, although in the laboratory experiments it was successful, and, therefore, Trewby concluded there was something wrong with the purifiers. The experiments failed till after the date of the patent, through the purifiers being out of order, as he said; and he stated that if they had not been out of order he should have found out that the suggested experiment was a great success. One of the points raised by the answer was that the plaintiff's letter of the 15th was a publication—that was to say, when a gentleman who had invented an ingenious and novel mode for getting over the difficulty of gas purification suggested to one of the principal men to try the experiment, and that person says, "I tried it and found it to be a failure; I tried it again after that, in the laboratory, and found it ought to succeed," that that is a publication. Mr. Patterson, in his affidavit, stated that he had examined the reports made by Mr. Trewby, and found that the lime purifiers at Beckton, from the 18th of February till the 9th of March, 1872, were worked in the following manner. Purifier No. 4 was put in action on the 10th of February, it became foul on the 14th, it was left foul till the 9th of March, thus remaining 23 days foul. No. 1 was put in action on the 14th of February, became foul on the 16th, taken out on the 26th, thus remaining 10 days foul. No. 3 was taken out 7 days after it became foul, No. 2 10 days after, and so on. Trewby's own record demonstrated that the lime in all the purifiers was kept unchanged, and not in action for a great many days; whereas by the plaintiff's process the first purifiers would be employed as decarbonators, and the lime changed immediately. The record showed that each purifier became foul in from two to four days—it became saturated with the impurities of the gas which began to come forward. The result of the evidence was that if gas were passed through a lime purifier, not too quickly, the lime took up both carbonic acid and sulphuretted hydrogen completely for a short time only, and after two or three days the lime became foul. It was proved that there were three volumes of carbonic acid in gas to one volume of sulphuretted hydrogen at Bow and Beckton; and when the lime became saturated, sulphuretted hydrogen came out, on account of the strong affinity of lime for carbonic acid; the acid did not come forward, but took the place of the sulphuretted hydrogen, and drove it forward, so that sulphuretted hydrogen was the forerunner of carbonic acid. That was true, with this correction—that if the gas was sent forward too quickly, both would come forward together; but if the speed were regulated, the lime would have time to take up all it could absorb. Mr. Trewby stated that he kept all his purifiers in a state of foul lime from 5 to 23 days; therefore, from 4 to 22 days those purifiers would each and all of them be sending out carbonic acid; so that, so far from taking out carbonic acid by that process, nothing of the kind was done. Mr. Trewby, even after Mr. Patterson's suggestion, did not know that it was essential to keep the purifiers any longer at work than they could absorb carbonic acid, which fully accounted for the failure of his experiments, putting aside the question of distortion altogether. What the plaintiff relied upon strongly was the fact that Trewby's experiments did fail, and that it was not until the 29th of March that Trewby satisfied himself that the suggestion of Mr. Patterson was worth anything. Then, on the 8th of March, a conversation took place between the plaintiff and Mr. Trewby; and the plaintiff's account is that Trewby stated he doubted the efficiency of the process with sulphide of calcium, and that Mr. Woodall, the engineer of the Phœnix Gas Company, had told him he had tried the experiment without success; but Trewby's account was that he said sulphide of calcium was an adequate purifying agent, although Mr. Woodall had tried it with but very little effect. On the 11th of March the plaintiff showed his specification to Mr. Phillips and some other agents of the defendants, and on that day Dr. Letheby made his first visit, and saw what was being done; and on the 18th he made the following report:—"In accordance with your request, I went to Beckton with Mr. Evans on Monday last, and examined, with his assistance, the details for the processes of manufacture and purification of gas, for the purpose of ascertaining the cause of the large excess of sulphur in the gas, and with the object of suggesting the means whereby the same might be obviated. The principal facts which came under our observation were that the lime purifiers were overworked, as regards duration of their action; that, with a view of employing the foul lime as an agent for absorbing bisulphide of carbon, as is done at the Great Central works, the lime has been kept too long in the purifiers, so that the carbonic acid in the foul gas had displaced, to a large amount, the sulphuretted hydrogen and bisulphide which the caustic and foul lime had absorbed. It appeared to me also that the condensation of the gas was not sufficiently effected and prolonged before the gas reached the scrubbers, and that the contact of ammoniacal liquor with the gas in the scrubbers was not maintained in the most advantageous manner. It seemed also that, by using water in the last of the scrubbers, too much ammonia was removed from the gas before it passed into the lime purifiers. The points, therefore, to which I would direct attention are the following:—1. Good condensation and prolonged contact of the raw gas with the products of condensation. 2. The working of the gas with ammoniacal liquor in some slow and continuous manner, so as not only to give time for the combination of bisulphide of carbon with sulphide of ammonium, but also to produce a liquor of not less than 16 oz. strength. 3. The use of lime in the purifiers for a much shorter time than is now practised—that is, for about 24 hours, instead of four days, after the purifier has shown signs of foulness. In this manner the sulphide of calcium of the foul lime will act as an absorbent of bisulphide of carbon, and will not afterwards be displaced by carbonic acid. 4 Care should be taken to keep a little ammonia in the gas until the very end of the processes of purification, so that it may react in the presence of lime upon the bisulphide of carbon and produce sulphocyanide of calcium. 5. This ammonia may be removed at last by either sulphate of iron or acid sawdust. The aim and object of these suggestions are to effect the absorption of bisulphide of carbon, which is acid in its nature, by the alkaline sulphides of calcium and ammonium, and also to permit of the reaction of ammonia and bisulphide of carbon in the lime purifiers, so as to form sulphocyanide of calcium. Mr. Evans will, I am quite sure, be able to appreciate the chemical principles involved in these suggestions, and will have no difficulty in bringing his large practical knowledge to bear on the questions so as to put them in the best available form. Such was the report of Dr. Letheby, and he asked, was there anything in that report about taking carbonic acid out, and then subjecting lime to the action of sulphuretted hydrogen, so as to turn it into sulphide of calcium. It was quite the other way, because the report recommended all the purifiers to be kept at work for 24 hours after showing signs of foulness. If that had been written before, it would not have been an anticipation of the process; and it was important as showing the state of knowledge at that time as to purifying gas from sulphur compounds. Dr. Letheby, like Dr. Odling, recommended a process, which every one admitted would not produce the effect which the plaintiff's patent was aimed at producing, and which it was admitted now it did produce. Mr. Phillips, in answer to Dr. Letheby, said if they were to change all the purifiers every 24 hours after showing signs of foulness, the result would be to incur an alarming cost. By the plaintiff's process the lime was changed the moment carbonic acid came over from the first and second purifiers, but the lime could be kept in the other purifiers for weeks. This was an enormous advantage over Dr. Letheby's process, for the cost would not be, as Mr. Phillips called it, "most alarming;" if it had been, it would have been fatal to the invention. On the 21st of March the Corporation of London complained to the Board of Trade of the amount of sulphur in the defendants gas; and on the 23rd Mr. Trewby wrote to Dr. Letheby, informing him what had been done to reduce the sulphur in the gas; that they had worked the purifiers, as was done at Bow Common and elsewhere—namely, by having three at work and one off, and working them in consecutive order. This had reduced the sulphur to a certain extent, but still the results were not what they could wish, for there was a large amount of carbonic acid after the gas passed the scrubbers, but this was reduced after it passed the condensers. On the 18th of February quite a new plan of working the purifiers was commenced—viz., by working four pairs in a set, the first two for carbonic acid, and the latter two for sulphur, the first vessel being charged directly it showed carbonic acid. The letter went on to say that frequently the first purifier showed sulphuretted hydrogen after from 12 to 24 hours working, and to change it as suggested by Dr. Letheby would considerably increase the cost of purification. On the 26th of March the referees sent in their report, dated the 31st of January, on the Beckton works, to the Board of Trade. Mr. Pierce, one of the referees, stated that in January, 1872, the plaintiff confidentially informed him and his colleagues of his discovery, and the process for using lime as well as other substances, and of his belief that he had discovered a solution of the sulphur difficulty, and that it was with the plaintiff's permission the lime process was given in their report, and also with a perfect understanding on the part of the referees that the plaintiff was to take out the patent before the issue of the report. That accounted for the fact that the report, although dated the 31st of January, was not presented to the Board of Trade till the 26th of March. The learned counsel then referred to the report of the referees which stated that the Beckton works had been planned with the highest ability; that no expense had been spared to ensure completeness and efficiency and; that all the apparatus were on an unusually extensive scale; that the purifiers were greater than in any other gas-works, so that it was confidently expected the amount of sulphur would be very small. This would have been the case if the process of sulphur purification had been understood; but the result had proved a complete and startling failure. The report then referred to the purifying area, quantity of gas made per hour at the various gas-works, and, after describing the mode of purification, stated that the gas made at Beckton was more impure than at any other works. Certain other alterations were made which for a time were successful, but ultimately they failed. The quantity of lime used in the purifiers was twice as much at Beckton as that used at Bow, although the same kind of lime was used. The referees, after careful inquiry, came to the conclusion that the causes of failure at Beckton were due to, probably, some defect in the distillation, and from an almost total failure in the process of purification; they did not think the fault was in the purifiers themselves, but they fixed upon carbonic acid as an important and unsuspected element of failure. The report went on to state that the referees felt assured that perfect results would be obtainable from the lime process of purification if carbonic acid were excluded from the purifiers, and also that the result would be adequate to the requirements of the public if the carbonic acid which entered the purifiers were kept down to the lowest point actually attainable in gas-works. The problem to be solved was, how to take out all the carbonic acid from the gas without simultaneously taking out all the sulphuretted hydrogen, which element was needed to convert the contents of the purifiers into sulphide of calcium. The essence of the difficulty consisted in the fact that carbonic acid existed in the gas in very much larger proportions than did sulphuretted hydrogen, while there was no chemical substance which absorbed carbonic acid without also absorbing sulphuretted hydrogen. Pending further investigations, the referees suggested that good scrubbers could take out of the gas twice as much carbonic acid as sulphuretted hydrogen. By improving the structure of the scrubbers, carbonic acid would be absorbed in greater quantity than at present, and the stronger the ammoniacal liquor became, the greater would be the reduction of the carbonic acid in the gas compared with the sulphuretted hydrogen. The learned counsel submitted that, until the time of the plaintiff's patent and the issue of this report, it was proved to demonstration that no one had brought a practical mode of working lime purifiers for gas into operation anywhere, although the chemicals were all known. There had been no book or publication of any sort or kind recognizing this as the practical mode of working lime purifiers until the report came out, which was after the date of the plaintiff's patent. The Board of Trade required that there should be no delay in fixing some maximum for sulphur, and in the last week of March, 1872, the referees issued, as usual, their instructions to gas managers for the ensuing six months, and therein announced that the maximum quantity of sulphur to be allowed, under penalty, in gas after the 30th of September would be 30 grains per 100 cubic feet. Copies of this report were a week afterwards sent to all the agents of the companies. Mr. Patterson, in the last week in March, 1872, attended a lecture on gas purification, delivered before the Royal Society, by Mr. Vernon Harcourt, in which

the lecturer stated that there was no material nor any means whatever for purifying coal gas from sulphur impurities other than sulphuretted hydrogen, except one particular process—namely, by passing the gas through hot iron pipes. Then a report was made by Dr. Odling. He went down twice, first on the 24th of February, and Mr. Trewby was there and showed him what was being done. The experiment, according to Mr. Trewby's knowledge and condition of it, was being tried, which the plaintiff had suggested. He went down again a little before the 28th of March. On one of those interviews the explanation was given to him. His report was dated the 28th of March, the patent then having been out some time. In that report he did not say the difficulty had been solved, or that there was a process known. He said he felt a difficulty from the very small amount of positive knowledge which existed on the subject. He said there was a very small amount of positive knowledge as to the means by which sulphur compounds were capable of removal from gas, and consequently he felt difficulty in reporting upon the subject. If the patent of the plaintiff had proved to be a success in manufacturing operations, then, according to Dr. Odling's statement, it was something better than was known at this time, and was a good subject of a patent. Dr. Odling said if they could get sulphide of calcium, and present the gas to it in such form as that it was apt for taking out the other sulphur compounds, they would have to keep it in operation for a long time. He said the first thing was to completely decarbonate the gas, founded upon the results of his observations connected with his laboratory experiments. He was running on the same road as the plaintiff, but it was mere suggestion, and he proposed it with diffidence. He suggested that for some months at Beckton the gas from the scrubbers should first be purified completely from carbonic acid, by being passed constantly through three or four lime purifiers in the usual manner, recharging the purifiers very frequently. He proposed to take the carbonic acid out first, then the sulphuretted hydrogen would turn other lime into sulphide of calcium. He said change the lime in the first three purifiers, so as to take the carbonic acid out perfectly, and then they might keep the lime in the rest for weeks, which was precisely the plan which the plaintiff patented. He (the learned counsel) thought he had shown from the written statements of the best chemists, whose attention had been most particularly directed to the question, what the state of their knowledge was, and what was the best plan they could devise for remedying the evil; and the suggestions came after experiments had been tried at Beckton. That produced from Dr. Odling a suggestion which was really identical with what the plaintiff had patented. Turning to the tables which the defendants had supplied themselves, it would be seen what took place after the patent was published. The respective average of maximum amounts of sulphur, in other forms than sulphuretted hydrogen, per month per 100 cubic feet of gas, at the works of the defendant company at Beckton and Bow, were given from October, 1871, till June, 1873, according to the official testings. It appeared that at Beckton, in October, 1871, the average was 39·2; the maximum, 50·0. November, average, 41·6; maximum, 52 0. December, average, 41·6; maximum, 55·0. January, average, 42·0; maximum, 53·0. February, average, 44·4; maximum, 51·0. March, average, 38·7; maximum, 53·6. The change began in the month in which the patent was published. What was the reason of the change? They were baffled until March. At Bow the average was—October, 1871, 24·0; November, 19·0; December, 22·0; January, 22·0; March, 22·0; April, 12·0. What made it come down from 24·0 to 12·0? The maximum was—October, 1871, 73·0; November, 32·0; December, 28·0; January, 35·0; February, 30·0; March, 36·0; April, 20·0; and it had never got higher than 20·0. Attention was directed by the referees to the large increase in the maximum in October, 1871, and Mr. Harris was unable to account for it, except upon the hypothesis of an accidental admission of air into the gas. The tables showed that the benefit of the plaintiff's plan was recognized and utilized, and that at once a change took place. But in about two months after the publication of the plaintiff's patent and of the report, which was put into their hands—about a week after its publication, in the beginning of April, 1872—an enormous change took place. It should be observed that the companies were only compelled to bring down their sulphur impurities to 30 grains per 100 cubic feet, but they brought them down eventually to about 11. Mr. Trewby said his attention was directed, in April, 1872, to the influence which the temperature in the purifiers themselves had on the purification from sulphur; and he tried a number of experiments, nearly all of which tended to show it was necessary to keep up a certain degree of temperature in the first vessels, in order to drive forward the sulphuretted hydrogen. The check purifiers were added on the 12th of May. On the 3rd of June the referees wrote to the board, saying they had much pleasure in informing them that since their report was placed in the hands of the gas referees, the sulphur impurities in the gas had decreased at Beckton and Bow. Mr. Chubb, the secretary of the Imperial Gas Company, by desire of his directors, protested against the sulphur maximum of 30 grains per 100 cubic feet enjoined by the gas referees, saying the directors believed it was utterly impossible to comply with it by any means then known, and would contest the right to fix such a maximum; and there were other protests of a like kind. Mr. Jabez Church delivered an inaugural address, as president of the British Association of Gas Managers, on the 11th of June, 1872.

Mr. SOUTHGATE: If it amuses my friend to read it, he may do so; but I shall object to it as evidence against me.

Mr. KAY: It does amuse me.

The VICE-CHANCELLOR: If there is anything amusing in this case I think we ought to have it.

Mr. KAY: In that address Mr. Church said the facts set forth by the gas referees were incontrovertible, and it now remained to devise a method for overcoming the difficulty. The problem to be solved was to devise some mode of taking out all the carbonic acid from the gas during its manufacture, without simultaneously taking out all the sulphuretted hydrogen. At the evening sitting a lecture was delivered by Dr. Odling, who said they were aware that trials and experiments out of number, and in ways most various, had been made in the use of both lime and gas liquor, to effect the desulphurization of gas, and although at times they had led temporarily to satisfactory results, they had not led to any method of procedure which could be constantly relied upon. Mr. Heisch was present at Dr. Odling's lecture, and in his evidence he said that after the lecture he met Mr. Trewby, who said what a shame it was for men to come and see what was done at gas-works, and then claim it for themselves. Mr. Trewby also wrote a letter on June 25, 1872, in which he said they were realizing what he told the referees some months since would be the case, that when the approved arrangements were completed they would be enabled to reduce the amount of sulphur, completely objecting to the maximum, and saying that some of the eminent chemists who had carefully studied the subject had not been able to come to any definite opinion on the question, and that he had made laboratory experiments, which had hitherto not given great results. He objected to the credit taken to themselves by the referees as to what they called their lime process, because he claimed whatever merit of originality there was in the process, which he said he commenced using in October of the previous year. He said he had devoted himself for months to the elucidation of the question, and had received no information from the referees, but had given information to them. So that the invention of the plaintiff, which was said to be without novelty, said to be useless, described in the evidence as being no invention at all, was now claimed as a new invention by Mr. Trewby, Dr. Odling, and by the plaintiff. Dr. Odling said he had not seen the referees report when he was led to recommend this, and Mr. Trewby said it was a great shame for other people to claim his invention, while, at the same time, he said his laboratory experiments were without any great result. Then, what was the law applicable to this state of things? Assume for a moment that Dr. Odling, Mr. Trewby, and Mr. Patterson had been at the same time trying experiments, which had convinced each of them about the same time that a certain process would remove the difficulty which for years all the best heads which had been applied to the particular process of purifying gas had failed to remove. Then one of those three inventors took out a patent, and for that he was entitled to protection. Upon this point the learned counsel referred to *Cornish v. Keene*, p. 508: *Galloway v. Bleadon*, p. 525; and *Carpenter v. Smith*, p 530, 1 Webster's "Reports." He also referred to *Bentley v. Fleming*, 1 Carrington and Curwen, p. 587. Mr. Trewby said he did not satisfy himself on the 20th of March that his experiments would succeed, and in his letter of June he said they were without any great results. Dr. Odling's recommendations were made after the patent was taken out, so that there was nothing but incomplete experiments down to the time of taking out the patent; and to that time the thing was never done as a manufacturing process, or the result now produced ever arrived at in any shape or way. He contended, therefore, that the patent was good, and that there was no publication of it by the plaintiff's letter, as was suggested by the defendants. Then as to the patent taken out by Mr. Mann. It was dated the 2nd of December, 1871, and sealed the 28th of May, 1872. Mr. Mann had set before himself the end to be arrived at accurately enough, but had not devised the means of arriving at that end; and how he missed it was, that he did not know it was necessary to take out the carbonic acid by a separate operation before the other compounds were dealt with. He left the carbonic acid out altogether, and did not recognize it as one of the impurities in gas which had to be got rid of. Everybody knew that sulphide of calcium was one of the best things that could be used to get rid of the impurities, if they only knew how to prepare the gas for it. Mann said, take one lime purifier, and pass the crude gas through it till it becomes sulphide of calcium. That would never be. Then shut it off, pass it through another which is to become sulphide of calcium; and from that purifier it is to go into the oxide of iron purifiers to get rid of the sulphuretted hydrogen, to be thrown aside, and then it was to go into the first purifier, which he supposed would be turned into sulphide of calcium. He said by this means it would be freed from carbonic acid and sulphuretted hydrogen. That was an admission that the lime in the first purifier would have taken up carbonic acid, but if so, it would not become sulphide of calcium. Therefore, Mann's patent, on the face of it, contained a positive contradiction—viz., that the one lime purifier was to produce two effects, to take up both carbonic acid and sulphuretted hydrogen, which would prevent it being turned into sulphide of calcium. The reason why Mann's patent never came into effective use was, that which he supposed was sulphide of calcium was not, in fact, so, but foul lime, and the patent had been allowed to drop, and the complete specification, not taken out until June, 1872, was after the plaintiff's patent. No doubt it was a very good attempt to produce a result at which all the inventors were aiming, but it missed it in the essential particular, that he did not say by a separate operation you ought to take out the carbonic acid, otherwise you could not produce sulphide of calcium in any quantities, but you would produce carbonate of lime, and the process would be, as it was, an utter failure. Upon this subject, *Hill v. Evans*, 4 De Gex, Fischer, and Jones, was an important case. Upon the question of infringement he would refer to the evidence of Mr. Trewby, who said that some time after May, 1872, two additional purifiers were erected outside No. 1 house. The whole of the gas to be afterwards purified in the houses, Nos. 1 and 2, was passed in one stream through one or both of those additional purifiers, which were called carbonate purifiers. One was charged with clean lime, and used at first alone. The gas was tested at the outlet of every house, for carbonic acid, about twelve hours before the time when, from previous experience, the purifiers were likely to show carbonic acid. The second one, charged with clean lime, was put in operation, and the gas that came from the former was passed through it. This was continued for some hours after the first purifier showed carbonic acid; then the first purifier was removed, and the second worked singly. After leaving the carbonic acid purifiers, the gas was split into two streams, each of which was passed through sulphur purifiers. Then they united and were treated with oxide of iron, to take away any sulphuretted hydrogen that might remain. That was identical with the plaintiff's invention.

Mr. FRY, Q.C., followed on the same side, and said the most convenient course would be that the evidence should be read, and then that the cross-examination should be taken. The first deponent was the plaintiff himself, his affidavit being filed on March 20, 1875. He said upon the passing of the London Gas Act, 1868, he was appointed by the Duke of Richmond, then President of the Board of Trade, one of the referees. He swore to his being the true inventor, and he described the principal impurities existing in coal gas as it issued from the retorts. He said he believed it was the fact that, until his invention became known, carbonic acid was contained in the gas supplied to the public by every gas company in London, and the mode of employing and working lime purifiers previously to the patent was to test the gas for sulphuretted hydrogen, but no lime testings were made for carbonic acid. He detailed the facts which have already appeared in the address of his counsel, and stated that the first germ of the invention occurred to him in 1870; that he made experiments, and seeing the important part which carbonic acid played in the purification of gas, he was ultimately led to take out his patent.

SATURDAY, DEC. 11.

Mr. FRY continued reading the evidence, commencing with the affidavit of Mr. Peirce, who had been one of the gas referees in conjunction with the plaintiff. He did not believe that the process which the plaintiff had patented was previously known, and considered it very valuable. Mr. Foster, secretary to the gas referees, said he was present at several meetings of the gas engineers and referees, at which the engineers stated they had no control over the sulphur impurities in gas. Mr. Jones, engineer to the Commercial Gas Company, knew the process patented by the plaintiff, and believed that up to the date of the patent it was not known. Mr. Livesey, secretary and engineer to the South Metropolitan Gas Company, had never heard of the process of gas purification patented by Mr. Patterson, until after the date of the patent; and in May and July, 1872, he, by desire of his directors, protested against the 30 grains maximum. Mr. G. W. Stevenson, C.E., consulting engineer to a great many gas companies at home and abroad, was intimately acquainted with the processes employed in the manufacture of gas from 1840 to the present time. He knew also the process patented by Patterson for the use of alkaline sulphides, and believed such process to be new. Mr. Gore, C.E., who had constructed and had the management of gas-works in Great Britian, and North and South America, had examined the process of the plaintiff, and believed it to be new and useful. Mr. George Anderson, gas engineer, had been a gas manufacturer for 25 years, and owner, or lessee and manager, of large works both in the United Kingdom and on the Continent. He had employed lime and oxide of iron in gas manufacture. Was well aware of all that had been done in the way of gas purification. Had never considered it necessary to test for carbonic acid, and never knew of its being done until after the publication of the gas referees report; and believed the patented process to be new. Dr. Stevenson, analytical chemist, had considered the process patented by the plaintiff, and believed it was both new and useful. Mr. Charles Heisch, F.C.S., &c., said that previous to the date of the plaintiff's patent he had never heard of the process being used in gas-works, and considered it new and efficient for the purpose.

TUESDAY, DEC. 14.

Mr. DAVEY, Q.C., proceeded with the reading of the evidence of the defendants, and, amongst others, read the affidavits of Mr. F. J. Evans, Mr. Robert

Harris, Mr. Carpenter, Mr. Mann, Mr. T. W. Keates, Dr. Redwood, Professor Wanklyn, Mr. Kirkham, Mr. Horatio Brothers, and Mr. Spice, all denying the novelty of the plaintiff's process.

Mr. FRY, Q.C., then read some evidence in reply, commencing with the affidavit of Mr. J. S. Peirce, one of the gas referees.

At the conclusion of this affidavit, the witness having been tendered for cross-examination,

Sir HENRY JAMES, Q.C., desired to cross-examine the plaintiff first.

Mr. *Robert Hogarth Patterson* was then sworn, and cross-examined by Sir HENRY JAMES.

I was educated as a civil engineer, and following that profession in the first instance. I had not much to do with the manufacture of gas. I was appointed a gas referee in 1868. I wrote a treatise upon gas purification in London. The first edition was published in 1873. That was after the question had arisen relating to the patent, and after the gas referees report. When I was appointed gas referee, we had only the Act of Parliament as our guide; no written instructions were given to us. We obtained them in April, 1872, after our report. In that report we did not think it necessary to state what we believed to be our duties; nor did I, at the time of making the report, regard it as part of our duty that the referees should give the public the fullest information, and we did so. We did not necessarily make suggestions. It was not part of our duty to do so; and I only did it, because I thought I should get credit for it. I intended to make my invention public after the patent. The referees report was completed on the 31st of January, and the patent was dated the 9th of March. Our report was not sent in to the Board of Trade earlier, because we were waiting for a report from the Beckton works, which was promised to us, but which we never received. That was my sole reason. The draft of the provisional specification was completed some time before it was published; but I cannot say exactly how long before. It was not completed on the 31st of January. I never intended to send in my report until I had registered the patent. I got my patent ready by the 9th of March, and the invention was discovered in the month of January. I cannot swear how long before the 9th of March the specification was complete. I fancy about ten days. Until I was appointed referee I had no knowledge, practically, of the manufacture of gas. I gained information whilst performing my duties as referee. My invention was made whilst I was gas referee, but not in consequence of any information which I received from the gas officers. That I swear. We visited certain works, and had compulsory powers to do so. I did not visit them in any other capacity than as referee. Some experiments were made by the directors and others to solve the difficulty of the purification of gas, and those experiments I have mentioned in my affidavit. The directors of the defendant company co-operated most cordially in making these experiments. They bore all the expense, and were entitled to recover them. I believe the engineers did everything in their power to render the investigation complete. I learned the results of the experiments as mentioned in my affidavit. I never personally made any practical experiments at any of the works. We made some ammonia experiments for Dr. Letheby. I gained no information from the experiments, except to find that they were an utter failure I believe I made my discovery sitting in an arm-chair. That is the best description I can give of it. I cannot fix the date. It might be walking in the street. It might be about Christmas, 1871. Until then I had not discovered it. The results of the experiments made at the gas-works were communicated to me very freely. The sudden thought came upon me which enabled me to solve the difficulty. All the essential features of the patent are not contained in the report. The lime process is. I did not communicate that which is the subject of my patent to Mr. Trewby before I drew up the report. It is not true that months before the 27th of March all the suggestions contained in the report had been communicated to Mr. Trewby and others; the causes of the failure had been. If I said the contrary in my letter of the 27th of March, it was a slip; you may say it was untrue. I had seen Mr. Trewby between the 25th of December and the 9th of March, and had had communication by letter with him. I had also seen Mr. Evans, and discussed with him the subject of the sulphur impurity, and how to get rid of it. I saw at Horseferry Road, about Christmas, Mr. Evans, and Mr. Phillips; also other officers of the company; and I told them the failure at Beckton was owing to the carbonic acid, but they did not believe me. Whether I intentionally kept back from them the discovery I had made in my arm-chair, or walking in the street, depends upon when I saw them. The referees asked for reports upon carbonic acid and sulphuretted hydrogen, and they were referred to in the report of the 31st of January. In the months of January and February, 1872, I was asking for reports from the Beckton works as to the causes of the failure, and what had been done to remedy it. I do not recollect that we received any replies. We had the tests for carbonic acid. We were trying to remove the sulphur. The proceedings at Beckton were in order to get rid of the sulphur impurities in gas in a very long roundabout way. What I communicated to Mr. Trewby, months before the 27th of March, was about the carbonic acid and the defective action of the condensers, the high temperatures in the scrubbers, and the carbonating of lime in the purifier. I did not tell him that I could get rid of the carbonic acid by employing some purifier for that purpose only. That was one of the things that I purposely kept back. I mentioned it in the report. That is one of the suggestions mentioned in the letter of March 27, in respect to which I made a slip. The whole character of the letter is a hurried note, written at the last hour, when the offices were shutting up, and the papers locked up. The works at Beckton were new works in 1871, and of unusual magnitude. It was not unnatural, I think, that at the outset there should be some defects of detail. I found some defects in the machinery used there, apart from the process; especially in the condensers. There was the great failure. We found the carbonic acid at Beckton just the same as at Bow. The condensing apparatus was inadequate. That had impaired the action of the scrubbers, and that in turn had impaired and almost neutralized the action of the lime in the purifier upon the sulphur; but not to the extent stated in the report. I say that speaking from the light I now possess. The report puts it stronger than was the case. That was my opinion on the 31st of January; but on the 27th of March it was not my opinion to the same extent. I did not send in a false report to the Board of Trade. We were waiting for some reports, and if we had received them we should have inserted them; but we did not receive them. The opinion expressed in the report was not fully supported by the testings alluded to in it; but we did not think it worth while to recast the report. On the 27th of March, I had not cleared up all the opinions I had. The report I made is fairly correct; but it is not sufficient to satisfy me now. Much depends upon the meaning you attach to scrubbing power. I did not feel myself bound to state all my discoveries in the report. Even now, with my fuller knowledge, I say the report contains a fairly correct statement. There is a difference in my judgment between "fairly correct" and "correct." I think the same thing might have been much more clearly and scientifically stated. I have not been to the works at Beckton since June or July, 1872. The improvements promised to be made in February, 1872, were to get rid of the impurity. On March 27 it appeared to the referees, as stated by them, impracticable to entirely exclude carbonic acid from the purifiers. Neither of my colleagues nor any gas engineer believed it could be done. The report was made by the referees, not by me only. I was a party to the report. The secretary signed it for the referees. I sent in such a report because I could not feel sure, although I believed it could be done; but it had never been proved. I did not tell my two colleagues that the statement was not correct, because I was not certain about it. Mine was the hand that drew up the report. In my opinion it was correct, and I sent it in because it represented the state of knowledge at that time. My own opinion could not weigh against the authority of the whole gas world. The referees suggested keeping the two first lime purifiers in each house in action until the carbonic acid had expelled the sulphuretted hydrogen and taken its place. That was one of the subjects of my patent. I consider the patent a valuable one, I have received no royalties up to the present time. Besides the defendant company, I believe my process has been used by the Imperial and the Phœnix. I have not granted a licence to any one. The present are the only proceedings I have taken. I consider they are quite enough; and if I am unsuccessful they will be more than enough. I admit that lime had been known and used as a purifier for gas long before my patent. It was known that lime, by absorbing sulphuretted hydrogen, became sulphide of calcium. It was known that lime would also absorb carbonic acid, and, having absorbed, would become part of itself. It was known as a chemical fact that lime had a greater affinity for carbonic acid than for sulphuretted hydrogen. I did not know it until I found it out. I discovered it by passing carbonic acid into a sulphurated solution of soda at the offices of the gas referees in the Adelphi. It pleased me very much. I do not know that it astonished me. I could not have taken out a patent for that discovery. I claim the employment of sulphides of calcium in separate purifiers as a means of purifing coal gas from sulphur existing in other forms than that of sulphuretted hydrogen. That is one of the things which I consider novel and original, and therefore claim as my invention.

Is the employment of sulphides of calcium in purifiers, as a means of purifying coal gas from sulphur, a novelty or not?—I am not quite certain that I understand you.

Was it, at the time of taking out your patent, a novelty to employ sulphides of calcium in purifiers as a means of purifying coal gas?—It is not easy to answer yes or no. Sulphides of calcium might exist in lime purifiers mixed up with carbonate of lime.

Was it a novelty or not?—I know that sulphide of calcium might be produced where lime purifiers were used, but I never heard of any means being taken to produce or employ it. I know that lime had been used as a purifier. When the lime had absorbed the sulphuretted hydrogen, it would become sulphide of calcium if it absorbed it alone. It had been so used that it had become sulphide of calcium in some cases, but they never deliberately produced it or employed it. My claim is founded upon the fact that the sulphide of calcium is in separate purifiers, as described in the body of the patent. I say that no such process as mine was ever used before. I claim a novelty for that which is indicated by the separate purifier. The object of the separate purifier is to create pure sulphide of calcium to any extent, so that in the first purifier the lime might absorb the carbonic acid, and so become carbonate of lime. It would be part of my system, when the first two purifiers showed carbonic acid, to change them. It would come within my patent if you worked with any number of purifiers; if with four, in the first two for carbonic acid, and in the last two for sulphuretted hydrogen. I have certain purifiers for the purpose of taking carbonic acid only, and the remainder for the sulphur. If Mr. Trewby, on the 18th of February, worked four purifiers in a set, the first two being for carbonic acid and the last two for sulphur, and then changed the first vessel as soon as it showed carbonic acid, that is the first thing mentioned under the first head of my patent. I know he did not do that from the working of his purifiers. I do not believe that, a few days before the 19th of February, he had kept certain purifiers for the purpose of taking the carbonic acid only, and the remainder for the sulphur. If he had done so, it would be my patented process. I have read the affidavits in the case, and my attention has been called to the affidavit of Dr. Letheby. He states that his visit to the works was made on the 11th of March, 1872, and that he found the company were working four purifiers in a set, the first two being for carbonic acid, and the last two for sulphur; but that was after my patent. I do not suggest that my patent had been seen between the 9th and the 11th, and then a visit made for the purpose of putting it in operation. I cannot doubt Dr. Letheby, but the records are irreconcileable with it. If that were true, there was a user of the subject of my patent.

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WEDNESDAY, DEC. 15.

Mr. *Patterson's* cross-examination by Sir HENRY JAMES continued.

Under my second head, I claim a method or system of employing lime purifiers, so that the contents of all the purifiers can be converted into sulphide of calcium, and also, if required, be maintained in that condition. When I use the word "series," as applied to purifiers, I use it in the singular. It is essential to my process to employ purifying vessels in two separate sets. I use the word "series" for the whole vessels.

Is it essential to your process, or a distinctive feature of it, the employment of two separate series of purifiers?—Will you tell me what you mean by "series."

I mean "series" in the sense in which you use it in your specification?—I really do not know what to say. I divide the "series" into two sets of vessels; the one for taking out the carbonic acid, and the second for taking out the sulphur. I say my specification discloses that there must be two separate series. Before I made my affidavit in reply, I had read Dr. Letheby's affidavit. When I took out my patent I had not read Mann's specification.

Mr. KAY: Mann's complete specification did not exist at that time.

Sir HENRY JAMES: Then he could not have read it. The plaintiff's complete specification was after Mann's complete specification.

Cross-examination continued: The employment of washers or scrubbers is not new. I had seen them at work constantly. They were employed for taking out the ammonia. The agent employed was water; it went in pure, and came out gas liquor. I have not known any alkali used in the washers or scrubbers. I claim, as a novelty, the use of caustic soda, potash, or ammonia. The discovery of that was theoretical, made in the manner before described. The employment of these alkalies in washers or scrubbers is described by me. It is part of my process that, before it goes into the washers or scrubbers, the sulphuretted hydrogen should have been previously eliminated, either by oxide of iron or otherwise. The sulphuretted hydrogen is to be eliminated in any vessel. The oxide of iron may be anywhere. It can be placed in the open air for the purpose of purifying gas from sulphuretted hydrogen. I would place the oxide of iron, in order to eliminate the sulphuretted hydrogen, anywhere. To satisfy the words "previously eliminated," it must be previously to the gas going into the washers. Under my patent, I claim that the sulphuretted hydrogen may be eliminated by oxide of iron, by passing it through vessels either before the washers or scrubbers, or before the purifiers. You may take it out of the soda itself, if you choose, in the washers or scrubbers. I consider that satisfies the words "previously eliminated." I do not put the oxide of iron in the washers or scrubbers, but in the purifier. I see no difficulty in satisfying the word "previously." My patent is for the use of alkaline sulphides, and my intention is that the purifier should be used either before or after the scrubbers. I say it is so described in the patent. I do not put the sulphide of calcium in the purifier, but in washers or scrubbers. There is no lime mentioned in the patent. It is part of my patent that the soda washers or scrubbers should be used before the vessels containing the sulphide of sodium. You may conveniently use them "next before." When the purifiers are charged with sulphide of calcium, it is prepared by the gas itself in the manner described. It is pure sulphide of calcium. The sulphide of calcium purifiers, of course, contain the sulphide of calcium already. I have described how to produce it, and the sulphide of calcium purifiers are charged with it. You may take out the carbonic acid by any alkalies you like. I leave in the sulphuretted hydrogen in producing it. It is not a separate manufacture.

Is it your intention to convey by this patent that, in order to get rid of sul-

phide of carbon you should, when you commenced the manufacture of your gas, pass your gas containing sulphuretted hydrogen over the lime, so as to get sulphide of calcium?—Yes. After I have got the sulphide of calcium by that means, I would then proceed to eliminate the sulphide of carbon. I should pass the gass into the lime purifiers till such time that the carbonic acid shall have expelled the sulphuretted hydrogen, and driven it forward, thus producing sulphide of calcium to any extent.

Would you commence your process by letting the gas come in contact with the lime while it contains sulphuretted hydrogen?—Yes.

And you would allow that to continue until the lime had become sulphide of calcium?—By taking out the sulphide of calcium.

Is it the fact that, for a certain time—that is, until the lime has become sulphide of calcium—you would pass your gas into it, containing sulphuretted hydrogen?—Yes.

When the lime has become sulphide of calcium, am I to understand you that you would then proceed to eliminate the sulphuretted hydrogen by means of oxide of iron or otherwise?—You can do it in that way, and that is one of the ways described by me. The fourth head, referring to washers or scrubbers, I consider requires no explanation; but there is an explanation on page 11. Under the fourth head I confine it to the soda washers. Soda had never been practically used before in washers or scrubbers that I know of. I have had no experience as to its employment in gas-works. Every alkali would do as well as soda. The ordinary washers or scrubbers are used for taking out the ammonia. I consider the third process described by me is better than the fourth. I do not think much of the fourth. If I employed the washer, containing a solution of caustic soda or potash, as explained under the third head, I should not want those under the fourth. Bisulphide of carbon is an acidulous substance, which may be acted upon, to some extent, by alkaline substances. It is acted upon by soda to a considerable extent. Mr. Vernon Harcourt thinks lime will do so also, but I know, from my own knowledge, that a solution of caustic soda will do. The only difference between the third and fourth heads is that the washers or scrubbers are to be used in a different way. The washers and scrubber mentioned under the fourth head must contain caustic soda. You can do the whole work of purification without a purifier at all. Under the fourth head purifiers are used last.

Is there any difference between your claim under the fourth head and your claim under the third head, except that the washers or scrubbers are to be used after the purifiers, instead of before?—Certainly. They are used for a different purpose altogether. I pass the gas over caustic soda in the washers or scrubbers, but you can do without purifiers. You can purify the whole without either lime or oxide of iron. Gas liquor may be fairly represented by the expression, ammoniacal liquor. If you causticize gas liquor it becomes caustic ammonia. My attention has been called to a patent taken out in 1866 by Mr. John Lees, but I was not aware that, in his patent, his fifth head was the use of distilled and concentrated gas water, however prepared, and whether causticized before or after distillation. I know Dr. Lees. He had not shown me the fifth head carried into effect. He only showed me putting sulphur into gas liquor. I have not seen what is comprehended under the fifth head anywhere at work. I arrived at the result I have stated from experiments at my office. As to its practical worth upon any large quantity, I have no experience. The "porous material" I used was sawdust, I think. It took out some sulphur. I cannot tell the quantity of sawdust I employed. What I mixed was sulphur with, I think, sawdust. I then put it into a vessel and passed the gas through it, and found it took some sulphur. That has not been adopted, but it satisfied my mind that I had made a discovery, though not a great discovery. I know that gas has been frequently passed over oxide of iron, and that it absorbs sulphuretted hydrogen. In course of time free sulphur accumulates in the oxide of iron. It is like iron rust.

The VICE-CHANCELLOR: Iron filings rusted?

Mr. ASTON: That is the form in which it is used.

Cross-examination continued: The effect of the action of the air on the oxide of iron when it has absorbed the sulphuretted hydrogen is, that the sulphur is deposited free. The iron becomes revivified. That would not be sulphur in a fine state of division in conjunction with an inert substance, as referred to by me. It is to get out the bisulphide of carbon that I apply that which is mentioned under the fifth head, and it is inert in relation to the bisulphide of carbon. But that would not satisfy the expression "inert substance," as used by me; though it is inert as regards bisulphide of carbon. The advantage of sawdust was that I found the mixture took out bisulphide of carbon. It might do better than oxide of iron. I say that oxide of iron in relation to the extraction of bisulphide of carbon will form a porous material when fixed in the sulphur in a fine state of division; but it is not, within the fifth head of the claim, an inert substance.

Re-examined by Mr. KAY: Oxide of iron revivified, though it contain a certain amount of free sulphur, will not, in practice, free gas from sulphide of carbon. Oxide of iron is not a suitable material, I should say, judging by results. The report sent in by the gas referees to the Board of Trade on the Beckton works was completed on the 31st of January; but it was not sent in until the 26th of March. My provisional specification was ready about 10 days before the 9th of March. In the interval, between the completion of the report on Beckton and its being sent in, I was engaged in preparing the provisional specification, and before that. I began to prepare my patent about the beginning of January. I cannot recollect when the actual preparation of the provisional specification was commenced. There is not much of it. Before I put it into writing, I made experiments which convinced me of the whole matter. The inventions were all ready before the end of January. The first time I got the specification, it was entirely different from what I intended it to be. It took some time to prepare. The reason for the delay in sending in the report was, that we were waiting for a report on what had been done by the defendant company to remedy the failure at Beckton; and the secretary requested us to keep back our report until that was sent in. My colleague knew that I intended to register my patent before sending in the report. I made a confidential communication of my patent to my colleagues in January. I also communicated it to the secretary. My last visit to Beckton was in July, 1872; I had not been there since about December, 1871. I was appointed a gas referee in 1868. Between 1868 and 1871 I had pretty frequently visited Beckton, and I was familiar with the processes carried on there. There was not, as far as I know, any process carried on at Beckton for taking out carbonic acid from gas in the first instance. I had no reason to suppose that anything done there was ever concealed from me. I examined pretty minutely what was going on; and I think it impossible that anything of that kind could have taken place without my knowledge, up to the 15th of December, when I last visited the works. Testings were sent to me from Beckton for October and November. I never heard of any other testings. There was among them no testing for carbonic acid in the gas. I remember in October, 1871, an additional lime purifier being put in at Beckton instead of one of the oxide of iron purifiers. I saw that in action. There was no testing for carbonic acid, when that was put in, that I ever saw or heard of. During the year 1871 I went to Bow, but not often. I could not say how many times. When I went I examined the process that was being carried on there. There was no change. There was no process at Bow, to my knowledge, for taking out carbonic acid from the gas as a separate operation. We had no testings sent us from Bow. No experiments were made at Bow by my direction. I once saw the purified gas tested—that was the gas ready for burning—and it contained carbonic acid. There were no other testings for carbonic acid at Bow, so far as I am aware. As gas referee, I had the inspection of about seven gas-works. I visited them all, and inspected the processes carried on. Neither at those gas-works, nor at any other that I know, was there any system for taking out the carbonic acid as a separate operation. In no gas-works that I know of, before the date of my patent, was there any proceeding for testing for carbonic acid in the gas as a regular operation. Testings were made by my direction at the works of the defendant company. Before my letter of the 15th of February, 1872, experiments were made for the purpose of inventing remedies, by my direction. There was a process of Mr. Vernon Harcourt's, which the President of the Board of Trade requested should be tried. It was tried at Horseferry Road without success. Another by Mr. Evans, for heated pipes, was tried without success. Another was, passing the gas while still containing some ammonia into the lime purifier, which had been strongly recommended by Dr. Letheby. That was tried, and was not successful. It did not get rid of the sulphide of carbon. I do not know of any other experiments made for the purpose of getting rid of the sulphide of carbon. No suggestions were made by me to take out the carbonic acid first until the 15th of February. My own private experiments were made at the laboratory in the gas referees office, just enough to settle the various points. My co-referees fully concurred in the report that we made. The condensers and scrubbers are used in most gas-works as the first process of purifying the gas after it comes from the retorts, by taking out the ammonia. When the gas comes out of the retort, it passes into a series of vessels, usually, of course, above ground, in comparatively narrow pipes, so that the external air cools it, and the tarry vapour which at first goes off the coals is deposited as tar. You thus get the gas free from tar. If this went forward, you would spoil almost everything afterwards. Inside the condensers no agent is used to purify the gas. Tar and some ammonia are removed. The condensed liquor is weakly ammoniacal. It contains tar, water, and some ammonia. The ammonia will be found, I have no doubt, in combination with carbonic acid and sulphuretted hydrogen. The scrubber is a tall vessel, filled usually with coke, or any inert substance, but not oxide of iron. The gas is allowed to enter at the bottom, and fresh water trickles in at the top. Of course, by the time it gets to the bottom, it is gas liquor. The gas goes out at the top through the wet coke. In the scrubbers no other agent is used than coke and water as purifiers. The action of the coke scrubbers on the gas is intended to take out the whole of the ammonia, and along with the ammonia some portion of carbonic acid and sulphuretted hydrogen, the proportions of which may vary according to the length of time the liquor is kept in contact with the gas. The gas liquor is an ammoniacal solution of varying strength.

By the VICE-CHANCELLOR: Gas liquor is an article of commerce. It collects at the bottom, being filtrated through the coke.

Re-examination continued: It is drawn off from time to time. The statement in our report as to the action of the antecedent vessels was too strong. When the report was framed, on the 31st of January, I had not received the result of the testings, but when I got them they showed us we had attributed too much to the inefficiency of the condensers themselves. It is the fact that you can take out all the carbonic acid by the washers and scrubbers by a particular mode of user; that is, by keeping the gas liquor so long in contact with the gas, that all the sulphuretted hydrogen absorbed by the ammonia is driven out, and carbonic acid solely taken up. It is possible, provided there is enough ammonia in the gas, but it has never been done to my knowledge. Why the gas liquor contained more carbonic acid in some cases than in others was never understood. Up to the time of our report the ammoniacal liquor had never been used for the purpose of taking out the carbonic acid as a separate operation. The quantity of ammoniacal liquor produced from a ton of coals is a tolerably fixed quantity; the only difference is that you may get it out weaker or stronger. If the scrubbers were larger the gas would be longer in the scrubbers, and the effect would be to make the liquor stronger. The stronger the liquor the larger the amount of ammonia taken up, and the larger the amount of acids. The proportion of carbonic acid taken out by scrubbers, as ordinarily used, depends upon the quantity there is in the crude gas. I think in crude gas there are about six or seven volumes of carbonic acid, compared with sulphuretted hydrogen, and at the issue of the scrubbers there are usually three to one. After passing through the condensers and scrubbers, as ordinarily used, the gas contains three volumes of carbonic acid to one of sulphuretted hydrogen. Those are the proportions obtained from the defendant's testings. The three volumes of carbonic acid are the largest amount of any one impurity existing in the gas at that stage. By "purifiers," as used in the report, I mean vessels other than condensers and scrubbers. A purifier is an iron vessel, round or square, fitted up with trays, in which either lime or oxide of iron is used. We recommended the reduction of the carbonic acid in the condensers and scrubbers, in the first instance, as far as possible. If it were possible we would get rid of it all in the condensers and scrubbers. Up to the time of our report there was no process known or used by which all the carbonic acid could be taken out of the gas in the condensers and scrubbers, as distinguished from the purifiers, and I do not suppose people believe in it yet; but I do. As soon as lime is incapable of taking up any more sulphuretted hydrogen, it is called "foul." The test for its becoming foul is acetate of lead. That is used to detect sulphuretted hydrogen. Where gas is foul, and has not lost its power of taking up carbonic acid, the sulphuretted portion takes up carbonic acid and becomes carbonated. Lime has a stronger affinity for carbonic acid than for sulphuretted hydrogen. Carbonic acid begins to come off in a quarter of the time it takes to saturate the whole vessel. Supposing it took four days to saturate the whole vessel, it would take an additional day before carbonic acid began to come off. At Beckton I think it is stated it takes 20 hours to become foul; and it would be one-fourth of that time longer before carbonic acid came off. The soda referred to in my patent will take out both carbonic acid and sulphuretted hydrogen from the gas, or carbonic acid alone. The gas, when it enters the purifiers, would have nothing in it but bisulphide of carbon. It would have lost the carbonic acid and the sulphuretted hydrogen. It would have spoiled the sulphide of calcium or the sulphide of sodium, if I had left it in.

Did you receive from Mr. Trewby, or from any other official of the defendant company, or indeed (I ask you generally), from any individual, any communication of your invention?—Not a scrap.

Were you told of any experiments whatever for the purpose of removing carbonic acid from the gas in the first instance?—No. Beside my letter of Feb. 15, 1872, I did not in any way communicate the principle of my invention to Mr. Trewby.

By Mr. DAVEY: I made my experiments in the referees office.

Mr. FRY proceeded to read the evidence in reply. The first affidavit was that of the plaintiff, Mr. Patterson, describing the process, which has already been given. Having carefully read the reports of the meetings between the gas referees and engineers, he stated positively that suphide of calcium was never mentioned as an efficient material for eliminating sulphur, and that it was the opinion of gas engineers that there were no known means for getting rid of the sulphur. He denied the statement of Mr. Evans that the gas purifiers had become distorted, thus allowing the gas to pass without coming in contact with the lime, and stated that if such distortion had taken place as stated, it must have been immediately detected by the absence of backward pressure. He repeated that on the 15th of March he told all the engineers of the company of the fact of having taken out the patent. He also repeated the denial that Trewby had ever communicated to him the method of working the lime purifiers in the manner stated by Trewby, and that he had never heard of any change in the purification having been made at Beckton until a few months ago. The series of testings made by Mr. Trewby at the inlet of the purifiers were made at the instance of Mr. Patterson and his colleagues, and never made

previous to the patent. He denied the allegation that Mr. Trewby had ever told his colleagues and himself that the defective purification of the gas at Beckton was caused by the undue presence of carbonic acid. He utterly denied that in June, 1869, or at any other time, Mr. Harris explained to the referees the action of the purifiers, or that he informed them, shortly after their appointment, that sulphide of calcium was a material for removing sulphur, or an efficient purifying agent. He then referred to the reports of the average amount of sulphur in the gas made at Bow from March to December, showing that the amount was reduced from 90 to 40 per cent.

Mr. DAVEY inquired whether it was suggested that Mr. Harris had used the plaintiff's process.

Mr. FRY said undoubtedly since 1872. Up to the time of the publication of the patent there had been considerable fluctuations, which meant absence of control; but after the date of the patent the fluctuations ceased, showing that they had discovered the key to the position. The affidavit went on to state that, when soda waste was tried by Mr. Harris, it resulted in a total failure. He also stated that although Dr. Letheby, who had been consulting chemist to many gas companies, claimed an antecedent knowledge of the lime process, he had again and again made public recommendations which were glaringly defective. The affidavit then referred to several statements, made by Dr. Letheby and Dr. Odling at lectures and elsewhere, as proving that their statements that there was no novelty in the patent were false. With regard to Mann's process, he stated it was not in use in any gas-works, owing to its defects and inadequacy. At the best, Mann's process could only produce foul lime in the ordinary state of saturation, but his specification contained no workable directions for obtaining even that small result. Referring to the statement by Drs. Letheby and Odling, as to the similarity of Harris's and Mann's process, the plaintiff stated the similarity was only superficial, and that, in fact, they were entirely different; and Mr. Mann, in May, 1872—two months after the date of the patent—stated that he knew of no means of dealing with the impurities. The next affidavit was that of Mr. Tropman Foster, secretary to the referees, in which he stated that he had read the affidavits filed on behalf of the defendants. He fully remembered the embarrassment felt by the referees on the ultimate failure of Mr. Evans's proposed sulphur test, and he reasserted the statement that he recollected Mr. Evans telling him in the autumn of 1871 that their hairs would be white before they solved the sulphur question. Dr. Stevenson, lecturer on chemistry, stated that, until he read the defendants evidence, he had never heard of Mann's patent. After describing the patent, he stated that it was merely a modification of the old faulty process of purification. He was still convinced of the novelty of the plaintiff's invention. Mr. Charles Heisch, superintendent gas examiner to the City of London, stated that Mr. Harris would never fix the sulphur maximum, although it was his place to do so. It was the fact that the sulphur in the Bow Common gas was for a long time kept low, but, after its incorporation with the defendant company, the amount increased very much, which Mr. Harris admitted to him he could not account for. As to Mann's patent, he stated there were not sufficient directions in it so as to work it with any certainty. He then referred to Dr. Odling's lecture, reported in the JOURNAL OF GAS LIGHTING. He was still convinced of the novelty of the plaintiff's invention. Mr. R. Jones, Mr. Livesey, and Mr. Stevenson, also made affidavits adhering to the statements in their previous affidavits. Mr. Gore stated in his affidavits, with regard to the purifiers, that no pressure to which they could have been exposed would have disturbed them so as to account for the failure in purification in any appreciable degree, and, even if it were sufficient to allow any gas to pass, the presence of sulphuretted hydrogen would immediately have ensued and been detected. The description given by Mr. Harris of passing gas through dry lime was incorrect. Referring to Mr. Mann's affidavit, where he spoke of the full directions given in his specification with regard to the working of certain purifiers, he stated that the directions merely showed that Mr. Mann did not regard the existence of carbonic acid as having any effect in modifying the condition of lime which it was proposed to convert into sulphide of lime; and, by the process described, the lime in one of the supplementary purifiers was merely converted into foul lime in the ordinary state of saturation. After reading and studying the several affidavits, he was still of opinion that until the date of the plaintiff's patent there were no efficient means known for removing the impurities from gas. The affidavit of Mr. George Anderson stated that working lime purifiers, in the manner stated by the defendant's affidavits, would not remove the amount of sulphur required by the Act of Parliament. He also agreed with the other witnesses that no disturbance of the purifiers could have taken place. Mr. H. E. Jones stated that he had given constant study and attention to all matters connected with the purification of gas, and had been in daily communication with those best informed on the subject, and had been fully conversant with the existing state of knowledge thereon. He stated that previous to the date of the plaintiff's patent no such process as the plaintiff's lime process was known in gas-works, nor was there any adequate or reliable means of purifying gas by sulphide of calcium.

At this stage of the proceedings the court rose, and the case was adjourned until Friday.

### FRIDAY, DEC. 10.

(*Before Vice-Chancellor* HALL.)

#### PEEL *v.* ACCRINGTON GAS AND WATER-WORKS COMPANY.

Mr. WM. PEARSON, Q.C., and Mr. W. BARBER appeared for the plaintiff in this case; and Mr. EDDIS, Q.C., and Mr. WOODROOFFE for the defendants, the company.

Mr. PEARSON said this was a bill by Mr. Jonathan Peel, and sought, in the first place, a declaration that according to the true construction of an agreement dated Oct. 6, 1846, and under the circumstances stated in the bill, the defendants are only entitled to the use of such of the spring water flowing from the plaintiff's estate, called the Hillock Estate, as has its source in a spring known as the Hillock Bank Spring, and another spring, near thereto, called the Gumbow Spring, and to only so much of the surface water flowing through or over the plaintiff's land as may from time to time naturally pass into the main drain of the company, without the aid of any cuts, drains, grips, or other artificial means; also a declaration that the defendants are not entitled to make or maintain any drains or channels through or across the plaintiff's land for the purpose of diverting any spring, surface, or other water, save the main drain before mentioned; also a declaration that the defendants are not entitled to divert or impound any of the water which, before the stoppage thereof by the defendants, flowed down an ancient watercourse into the farm known as the Miry Lane Farm. The bill also asked that the defendants might be ordered to fill up any of the drains, &c., which they had, as alleged, improperly made; to restore the surface; for an injunction to prevent the commission of such acts in future; and for an inquiry as to damages. The short facts of the case were as follows:—The plaintiff, Mr. Jonathan Peel, the owner of an estate called the Hillock Estate, at Accrington, in the year 1846 made an agreement with the defendants, under which the latter were entitled to take the water from a particular spring, called the Hillock Bank Spring. Whilst the drain was being made for the purpose of conveying the water from this spring, another spring was discovered, and it was verbally agreed that the defendants should take the water from that also, which was called the Gumbow Spring. The ground of complaint was that, whilst by the terms of the agreement the defendants were restricted to taking the water from those two springs by a main underground drain, and carrying it away to their works; and to such water as might naturally flow from the surface of the land into such main drain, they had, in fact, gone on to the plaintiff's lands and made divers drains and cuts, by which they had carried off the water of other springs. At the time the agreement was entered into, the land was simply agricultural land; but since then the plaintiff had demised considerable portions of the estate for the purpose of erecting cotton-mills and other factories, giving them the usual rights of water, which were of great importance, but of which the defendants were now depriving them. The second point was this: that there was an ancient watercourse, which flowed down a lane, called Back Lane, into the Miry Lane Farm, belonging to the plaintiff, and that the defendants had intercepted this water, and caused it to flow by a pipe into their own reservoirs. The learned counsel handed up to the Vice-Chancellor two plans showing the *locus in quo*, with the springs delineated thereon, and the drains made by the defendants, including the main drain, which they were entitled to make for the purpose of conveying the water from the Hillock Bank and Gumbow Springs, and also various other drains which the plaintiff alleged they had improperly made, running into this main drain, and so collecting the surface water from the plaintiff's land. On that part of the case, he understood, the defendants contended that such works were not a breach of that portion of the agreement, which provided that they should be entitled to such water as naturally flowed into the main drain. On the second point, they denied that there was a natural watercourse down the Back Lane, and that they had diverted it to the injury of the plaintiff. The learned counsel then went through the bill, which stated the above facts in greater detail, setting out the agreement in full, which was made in 1846, under which the defendants were to pay a yearly rent of £43 for the water. With regard to the alleged diversion of the water from Back Lane, the defendants stated in their answer that about 1872 the District Surveyor of Highways applied to them, as being mainly interested, to cut a channel down the side of the lane, in order to prevent the water injuring the surface of the road in stormy weather, which they had done; and at a point below the Miry Lane Farm they had put a pipe to convey the water to their reservoirs.

At this point the case was adjourned to the next day.

### SATURDAY, DEC. 11.

Mr. PEARSON resumed his argument to-day, after the disposal of several other matters. He continued his statement of the answer of the defendants, the principal effect of which was that they were entitled, under the agreement, to make the cross drains now complained of, and that if they were not, it had always been so interpreted by the respective parties, and that all that had been done was with the consent of the plaintiff. The issues raised on the pleadings were these—that the defendants were authorized, under the agreement, to make the drains; that, having been made, the plaintiff had no remedy in this court; that some of the drains made in 1874 were so made with the authority of the plaintiff; that it was an improvement to his land, and therefore they were entitled to make them; that the plaintiff had been guilty of *laches;* and that the defendants were entitled by prescription, having enjoyed the rights they claimed for more than 20 years.

The learned counsel then proceeded to read the evidence on each side, which had not concluded when the court rose for the day.

### MONDAY, DEC. 13.

The evidence was continued this morning, but Mr. EDDIS had not proceeded very far with that put in by the defendants when

Mr. BARBER stated that the parties had come to a settlement, the terms being in substance that certain alterations should be made by the defendants in the drains and pipes, abandoning some which were particularly objected to; that a proper plan of the easement should be drawn up to avoid any future disputes, and that the defendants should pay £125 to cover all costs and damages.

The VICE-CHANCELLOR intimated that he considered this a very reasonable mode of settling the question.

## Miscellaneous News.

### METROPOLIS GAS SUPPLY.

LAMBETH VESTRY.—At the Meeting of this Vestry on Thursday last, a report was presented by the Lighting Committee, in which they stated that they had received information that the South Metropolitan Gas Company intended to promote a bill in the next session of Parliament, in which they proposed to adopt a sliding scale of dividends, under which they would be allowed to divide a larger profit than 10 per cent., so long as the price charged by them for gas was less than 3s. 9d. per 1000 cubic feet. It was resolved by them to defer the consideration and report upon this subject until the bill is deposited, meantime the committee recommended that they should be empowered to engage the service of parliamentary agents if they should consider it necessary to do so. Upon reception of this report, the vestry resolved—"That, as the South Metropolitan Company are supplying 14-candle gas at 3s., and can supply 16-candle gas at 3s. 3d. per 1000, and yet make a dividend of 10 per cent., it would be most unjust, by any legislation public or private, to sacrifice the interests of South Metropolitan consumers by enabling the company to charge 3s. 9d. for 16-candle gas, and make dividends of 12 or 13 per cent.; that this vestry will oppose any measure involving this result, and will invite the co-operation of other vestries in such opposition." It was also resolved that a copy of this resolution be forwarded to the county and borough members, and the representatives at the Metropolitan Board.

Dr. Whitmore's report on the illuminating power, pressure, and quality of the coal gas consumed in the parish of Marylebone during November :—

| 1875. | Illuminating Power in Sperm Candles. | | | Mean Pressure in Tenths of an Inch. | | Mean Quanty. of Sulphur in 100 Cu. Ft. | Mean Quanty. of Ammon.in 100 Cu. Ft. | Sulphuretted Hydrogn. |
|---|---|---|---|---|---|---|---|---|
| | *Mean of 24 Obser. | Highest. | Lowest. | Highest. | Lowest. | Grains. | Grains. | |
| Imperial Comp.'s gas | 16·07 | 16·81 | 15·21 | 25·85 | 9·12 | 16·15 | 0·70 | No trace |
| Chartered Comp.'s common gas | 15·89 | 16·41 | 15·24 | 28·25 | 14·78 | 14·64 | 0·55 | No trace |
| Chartered Comp.'s cannel gas | 20·08 | 21·01 | 19·31 | 18·07 | 11·51 | 18·16 | 0·83 | No trace |

Mean of daily readings of barometer . . . . 29·60
" " " thermometer . . . 57·32

* Each observation consists of ten readings of the photometer, at intervals of one minute.

The mean illuminating power of the Imperial Company's gas during the month was equal to the light of 16 sperm candles; it ranged between 15·21 and 16·81 candles; 16 times it was over 16 candles. The mean amount of sulphur found in 100 cubic feet of this gas was nearly 19 grains, and of ammonia 7·10ths of a grain. The common gas of the Chartered Company gave a mean light equal to very nearly 16 candles; it ranged between 15·24 and 16·41 candles; on 11 occasions it was over 16 candles. The mean quantity of sulphur found in it was 14½ grains, and of ammonia half a grain. The cannel gas gave a mean light equal to 20 candles, and ranged between 19·31 and 21·01 candles. The mean quantity of sulphur found was 18 grains, and of ammonia 8·10ths of a grain. The pressure of all three gases was generally good, and on

no occasion was sulphuretted hydrogen detected in either of them by the ordinary tests. The insufficient amount of light complained of by several consumers in the parish during the month was not due to a want of pressure, but to the formation of naphthaline in the pipes and mains, for which the gas companies cannot be held responsible, inasmuch as any method of preventing it has not yet been discovered. The above results were obtained from the gas manufactured by the Imperial Company at their Fulham works, and from the Chartered Company's gas manufactured at their works, Beckton and Bow.

## METROPOLIS WATER SUPPLY.

LAMBETH.—"A Report upon the Accounts and Charges of the Water Companies and the Proposed Legislation in 1876," has been presented to the vestry of this parish by a member of their own body, Mr. W. Storr. The vestry have practically endorsed the statements contained in the report by ordering 1000 copies to be printed and circulated.

After alluding to the complaints against the water companies as set forth in Lord Camperdown's letter, in reference to the apprehended increase of assessment next year under the Metropolis Valuation Act, Mr. Storr sets out the remedy proposed by the Metropolitan Board in the bill which they intend to introduce to alter the terms on which water is supplied in the metropolis, and to provide for the right of consumers to be supplied by meter. He then proceeds to consider what the answers of the companies to the complaints against them may be:—

On their behalf it will be contended—

1. In increasing their charges with the increase in the assessment, they have done only what they were entitled to do by Act of Parliament. In some instances values have been reduced; and if a house is placed in a lower class in either of the company's scales the occupier is entitled to a corresponding reduction in the charge for water. In these instances, as in those in which values are raised, the consumption of water will probably continue to be in the future as large as it has been hitherto; so that in some instances the companies will be charging less, just as in others they will be charging more, for the same supply.

2. The companies are acting equitably towards all their customers. New property is first valued according to the basis of the new assessment, and new property would therefore pay for its water supply at a very much higher rate than old property if the value of old property remained stationary for the company's purposes. The disparity between the oldest property and the newest property would increase with each assessment. If a company were approaching its maximum dividend, adherence to the old valuation of old property would delay the reduction of the per centage and other charges to all consumers.

3. In some cases in which complaint is made of the conduct of the companies in raising their charges, the explanation has been that, owing to oversight on the part of the companies, houses have been undercharged apart from the assessment. If there be any cases in which the companies have exceeded their legal powers, individual consumers have the remedy in their own hands, for the companies cannot charge more than they are entitled to charge by their Acts of Parliament.

4. In many cases irritation is due to ignorance of the basis upon which the charges are made; and it would be satisfactory if the scale were accessible. The Lambeth Company does provide a printed slip for distribution, and it is sent to any consumer who asks a collector for information; but the Southwark and Vauxhall Company does not adopt a plan so obviously convenient, and inquirers by letter are referred to the company's private Act, which, as compared with a public Act, is practically inaccessible.

Mr. Storr proceeds to institute a comparison between the scale of charges made by the two companies supplying the south side of London, showing that the Lambeth Company's scale is much the higher of the two. The per centage of the Southwark and Vauxhall is 5 throughout; that of Lambeth is higher than 5, until the annual value exceeds £100. For closets and baths the Southwark and Vauxhall charges are much lower. In the case of a £45 house, with a closet and bath (suppose the Lambeth full rates to be charged), the difference between the two companies is £1 7s., assuming the Lambeth Company to charge 10s. for a bath, as they may do, the charge not being determined by the Act of 1848.

The writer then gives an analysis of the accounts of each company, upon which no remarks need be made, as our own annual abstracts supply all the materials for a clear understanding of the matter. He then goes on to deal with—

*Objections to Water-Meters.*

As to one of the remedies proposed by the Metropolitan Board of Works—viz., the granting to consumers of the option of paying for water consumed as indicated by meter—it will be contended, on public grounds—

1. It is inexpedient to restrict, by considerations of expense—and in many cases inexpedient in proportion to the extent that expense is a consideration—the use of water for domestic purposes, because, within certain limits, the plentiful use of it is essential to the maintenance of the public health.

2. The supply of water to a community, although undertaken by a private company, is much more a matter of public than of private concern. The adoption of value as the basis of charge is less a measure of the consumption of water than a measure of the obligation of occupiers of property to contribute towards the first cost and the maintenance of works which are indispensable to the community as a whole. True, any one may dispense with a company's water at present and thus evade the obligation; but so few can do so that the principle involved has never been worth discussing. If, however, it were possible for any considerable number of householders, by reducing their consumption of water and measuring it, materially to reduce the aggregate of their contribution to the cost of maintaining the water-works and paying the interest of the capital expended upon them, either an unfair proportion of the cost must be thrown upon other consumers, or the charges would be revised by Parliament so as to make the revenue pay a fair dividend upon the capital raised under the authority of Parliament. The capital outlay for the interception, storeage, and pumping of water has been sanctioned with a view to the maximum requirements of both property and population. It may be that the watering of roads and the flushing of drains are paid for out of the general rate; but the provision of water for the protection of life and property against fire, and storing of water against seasons of drought, being obligations which are (or ought to be) imposed upon companies, in the public interests, it is a public question whether any individual can be permitted to evade his personal liability in these respects, either as an occupier of property or as a member of the community, by reducing his consumption of water to a minimum. He cannot, as an occupier of property, evade his liability in respect of the paving, lighting, and watching of the streets, by restricting his use of them; and it will be contended that occupation of property is equally a ground for levying a contribution proportionate to its value towards the cost of the general water supply for the community which enhances the value of that and all other property. Even as to consumption of water, the cleansing of a large house must (or ought to) require more water than the cleansing of a small house, so that it does not follow that a large family in a small house consumes more than a small family in a large house.

3. The cost of meters must be borne by the consumers; they will therefore add to the cost of the water supply. The cost and the trouble of introducing them will deter many from adopting them. If they are adopted to any large extent, the aggregate cost to the public will amount to a sum which had better be devoted to improving our water supply, making it constant, and putting it upon a different footing—one admitting of use without stint, and under which surplus income will belong to the public—one, in fact, under which meters could be neither necessary nor permissible to domestic consumers. The introduction of meters would be a benefit only to a particular trade.

It is for the vestry, under these circumstances, to consider whether they can support the Metropolitan Board in proposing to adopt the principle that any householder in the metropolis, rich or poor, occupying a large house or a small one, may limit his obligation in respect of water supply, by reducing his consumption to a minimum, perhaps at a sacrifice of health, and paying for a measured quantity only.

The next questions discussed in the report are whether "annual value" shall be considered to be "gross or rateable value," the writer admitting that "value seems to be the only basis of charge which is at once equitable and practicable;" and the extra charges for gardens, baths, and closets. He also quotes at some length from the last report of the Rivers Pollution Commission in condemnation of the Thames water supply, and concludes with the following propositions for the consideration of the vestry:—

That a comparison of the scales of charges for water for domestic purposes which the Lambeth Water Company and the Southwark and Vauxhall Company are authorized to levy, under their private Acts, shows that there is a great disparity between the two, which does not appear to be justified by special circumstances; that the enforcement of the higher scale of the Lambeth Company has occasioned much dissatisfaction, particularly when the authorized per centages were charged upon increased assessments under the Revaluation Act; that the charges of the Lambeth Company are excessive and burdensome and ought to be reduced; and that it is very desirable that the two companies should have a uniform scale of charges, and should be required to supply copies of that scale to the consumers of their water. That, on sanitary grounds alone, it is highly inexpedient, because it might be detrimental to the public health, that the use of water for domestic purposes should be restricted, as it would be, by the adoption of the measured consumption as the basis of charge. That the provision of an adequate supply of water for a large community, whether entrusted to a private company or a local authority, enhances the value of all property, facilitates sanitary administration, furnishes some protection to life and property against fire, and is on these grounds more a matter of public interest than of private trading; it is, therefore, equitable that the cost of such an undertaking should be borne rateably by the occupiers of property, and it would be unjust that any occupiers or owners should be allowed to evade their proportionate liability by restricting their consumption of water and paying only for the quantity consumed. That besides being inequitable, and inexpedient on sanitary grounds, anything like an extensive adoption of meters will involve an enormous expenditure which will be practically useless, and beneficial only to a particular trade. That while it is right, on broad public grounds, to retain annual value as a basis of charge, it is desirable to determine authoritatively that rateable value is intended. That it is desirable, in the interests of the public health, to encourage the provision and the use of baths in private houses, and that a restrictive charge for supplying them with water is contrary to public policy. That baths, closets, and gardens are all elements in the annual value of a house, and increase that value, and therefore the supply of water to them ought to be declared a domestic purpose, to be covered by the charge on rateable value, except in the case of gardens exceeding a defined area. That as the report of the Rivers Pollution Commission emphatically condemns Thames and Lea waters as unfit for dietetic purposes, the Thames water companies ought to be prevented at once from raising further capital to be expended in permanent works at their present sources of supply; and that it is the imperative duty of Her Majesty's Government and of the Legislature to lose no time in creating for the metropolis a local authority which may be empowered and entrusted to obtain water from purer sources than the Thames and the Lea.

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The Registrar-General publishes the following returns of the average daily quantity of water supplied by the London Water Companies during the month of November, 1875. According to their returns, 109,998,971 gallons, or 499.776 cubic mètres of water (equal to about as many *tuns* by measure, *tons* by weight) were supplied daily; or 213·5 gallons (97·0 decalitres) rather less than a *ton* by weight, to each house, and 30·1 gallons (13·7 decalitres) to each person, against 30·5 gallons during November, 1874. According to returns of the London Water Companies made to the select committee on East London Water Bills (session 1867), it is estimated that, during the year 1866, about 82 per cent. of the total average daily supply of water for all purposes was for domestic use; applying this proportion to the total quantity supplied daily in the month of November, 1875, it may be estimated that about 90,199,156 gallons were probably used for domestic purposes, or about 24·7 gallons per day for each inhabitant, against 25 0 in the corresponding month of last year. This proportion, no doubt, varies from month to month, but the Registrar General has no means of giving a more exact estimate.

| Companies. | Number of Houses, &c., supplied in Nov., 1874. | Nov., 1875. | Aver. Daily Supply of Water in Gallons* during Nov., 1874. | Nov., 1875. |
|---|---|---|---|---|
| Total supply | 513,772 | 515,337 | 111,277,035 | 109,998,971 |
| From Thames | 241,404 | 239,345 | 57,439,311 | 55,823,860 |
| „ Lea and other Sources | 272,368 | 275,992 | 53,837,724 | 54,175,111 |
| THAMES. | | | | |
| Chelsea | 28,490 | 28,600 | 7,514,000 | 6,911,700 |
| West Middlesex | 46,363 | 47,330 | 9,068,251 | 9,213,565 |
| Southwark and Vauxhall | 79,852 | 80,295 | 18,000,500 | 18,750,300 |
| Grand Junction | 35,144 | 30,036 | 10,239,160 | 8 580,495 |
| Lambeth | 51,575 | 53,084 | 12,617,400 | 12,367,600 |
| LEA AND OTHER SOURCES. | | | | |
| New River | 122,748 | 123,888 | 26,086,000 | 25,207,000 |
| East London | 106,459 | 107,851 | 21,614,500 | 22,697,500 |
| Kent | 43,161 | 44,253 | 6,137,224 | 6,370,611 |

* Including that for manufactures and for various purposes other than for domestic consumption.

*Note.*—The return for November, 1875, as compared with that for the corresponding month of 1874, shows an increase of 1565 houses, and a decrease of 1,278,064 gallons of water supplied daily.

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Dr. Frankland, F.R.S., as the result of his analysis of the water supplied to the metropolis during November, reports that, taking unity to represent the amount of organic impurity in a given volume of the Kent Company's water, the proportional amount found in an equal volume of the water supplied by each of the other metropolitan companies was—New River 3 6, East London 4·6, Lambeth 6·3, West Middlesex 7·0, Southwark 7·2, Grand Junction 7·4, and Chelsea 7·8. Owing to the heavy floods, the river water during November was polluted with "large quantities of suspended impurities, and of soluble organic matter of a brown colour," and the five water companies drawing their supplies from the Thames delivered, almost throughout the month, water which was "quite unfit for domestic use, even after efficient filtration." Dr. Frankland further reports, however, that the West Middlesex was the only one of the five companies which delivered water that had been efficiently filtered; the water of of the four other companies being turbid, and containing moving organisms. The Grand Junction water "gave a deposit consisting chiefly of matted fungoid fibres." The New River and East London Companies supplied water of a superior quality, that had been efficiently filtered; while the Kent Company's water, derived from deep wells in the chalk, was as "pure, brilliant, and palatable as usual."

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Dr. Whitmore's report on the composition of Thames companies and other waters supplied to Marylebone during November:—

| 1875. | Total Solid Matter in degrees or grains per Imperial gallon. | | * Loss by incineration of Solid Matter in previous column. | | Hardness before boiling, in degrees. | Hardness after boiling, in degrees. |
|---|---|---|---|---|---|---|
| | Nov., 1874. | Nov., 1875. | Nov., 1874. | Nov., 1875. | | |
| | 0° | 0° | 0° | 0° | 0° | 0° |
| *Distilled Water* | | | | | | |
| West Middlesex water | 19·96 | 21·52 | 0·88 | 0·96 | 14·57 | 3·14 |
| Grand Junction water | 20·24 | 22·96 | 0·00 | 1·04 | 15·41 | 3·42 |

* The loss by incineration represents the amount of organic and other volatile matters contained in the Imperial gallon (70,000 grains) of water.

The water supplied to the parish during the month by both the Thames Water Companies was generally clear, bright, and well filtered; occasionally it was slightly turbid, a fact easily to be accounted for by the wet and stormy weather which prevailed in the early part of the month; the slight excess of solid matter contained in it was also due to the same cause.

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Major Bolton reports that during the month of November the state of the water in the river Thames at Hampton, Molesey, and Sunbury, where the intakes of the West Middlesex, Grand Junction, Southwark and Vauxhall, Lambeth, and East London Companies are situated, was extremely bad for the greater part of the month, the river being in a state of flood owing to the heavy rains. The

highest flood state of the river at Hampton during the month was 7 feet above the (6 feet) summer level, and the lowest was 1 foot 5 inches above summer level. On the 26th of October the water rose 2 inches higher than on any previously recorded occasion of flood, but on the 18th of November it rose 15 inches higher still. At Seething Wells, Kingston, where the intake of the Chelsea Company is situate, the state of the water in the river was very bad during the month. The highest state of the flood water at this place was 8 feet 7 inches above, and the lowest was 2 feet 3 inches above summer level. The highest temperature of the water during the month was 47°, and the lowest 36°, while the highest temperature of the air at the same place was 60°, and the lowest 32°. These observations were made daily at nine a.m. The rainfall during the month was 3·81 inches. The river was much polluted by the effluent waters bringing down from the land large quantities of marl and clay, as well as decayed vegetation, and other impurities, which stained the water and rendered it exceedingly turbid. The impurities in suspension were to a great extent removed by filtration, but the matter in solution passed through the filter-beds, causing the filtered water to be stained with a brown colour. By previous subsidence, for several days, effectual filtration is greatly facilitated. Of the companies drawing their supplies from the Thames, the West Middlesex and Lambeth are the only two that have at present sufficient storeage capacity, or impounding reservoirs, to avoid taking in water when floods prevail. The water supplied by the West Middlesex Company during November was clear and efficiently filtered; the excellent quality of the water supplied by this company is mainly attributable to its having been taken in at times when the river was at its best, and allowed to subside previous to being filtered. The Lambeth works being new are not yet in such good working order as the West Middlesex, and consequently the water supplied by them is indifferent in quality; when the filtering works of this company are completed their supply should equal the West Middlesex Company's in quality. The Chelsea Company are proceeding with the construction of the requisite subsiding reservoirs at Molesey, and the Southwark and Vauxhall and Grand Junction Companies are preparing to construct suitable storeage at Hampton; when these companies have completed their works they should be able to avoid the floods, and supply water of a better quality and effectually filtered. The water supplied by the East London and New River Companies during November was clear and properly filtered; the large impounding reservoirs possessed by these companies enabling then to draw their supplies from the water stored in their subsiding reservoirs, and by doing so avoid the floods. The Kent Company delivered water of the usual excellent quality during the month. When the New River Company engaged, about nine years ago, in the sinking of a new well into the chalk formation at Turnford, they arranged to have the shaft of this well and machinery so made that there might be a convenient subsequent attempt to obtain at that place a fresh supply of water, by a large bore into "the *lower green sand*." Such bore was commenced at the beginning of last year (1874), and it has now reached a depth of 740 feet from the surface; at this depth it has entered the "marl" below the chalk, and is now being widened out to the diameter of 34 inches preparatory to the insertion of the tubes, which will be required for further boring through the "marl" and "gault." Early in the present year the same company arranged for the execution of several important additions to their distributory works; these are to provide for the increasing demands of their district; to make more perfect the separation of the very different levels of their service into convenient "zones," and to add to the power and means of communication, by which their different stations are enabled to assist one another. The intended works include five new filtering beds at Hornsey, of a joint area of 3½ acres; four new engines at the same place, of a joint power of 440 horses; a new high service reservoir on Crouch Hill, to be capable of holding about 12 millions of gallons of water, and about 13 miles of large mains to be laid down as lines of communication between the works just described, and for connexions with existing pipes. Two of the said new filtering-beds are by this time nearly finished. The engines and engine buildings are in progress, and the lands which are required for the other beds and service reservoir referred to have been bought. The East London Company have given notice of their intention to extend it to some 3400 houses after the 1st of March. A further notice was given on the 25th of November last that the company propose to give, on and after the 1st of April and the 1st of May next respectively, a constant system of supply to two new districts, containing in all about 2900 houses. The Grand Junction Company are erecting new boilers and works at Hampton; an extra 30-inch main from Hampton to Kew has been completed, and also a new 12-inch main from Kew to Notting Hill. to supply the low service in this portion of the company's district. The Chelsea Company's new works have been commenced, the pumping main will probably be laid and in use before the end of the year, by which the company will be enabled to supply their district with better water. The directors state that they are confident that when the new reservoirs shall have been completed the quality of the water delivered in their district will be unexceptionable. The impounding reservoirs are progressing upon the land (comprising an area of about 50 acres, necessary for their construction), near Molesey, and the iron mains are being laid on the line of conduit. The erection of the necessary engine power is in progress, and meanwhile temporary engines are being fixed to afford a supply from the new intake, and the company are endeavouring to complete the new works as soon as possible, the urgency of which is apparent, as at the present moment they have no subsiding reservoirs; they have to take in their water day by day from the river, and it is only by the exercise of the greatest care and attention to their filter-beds that they are able to supply water fit for use at any time, while during the floods it is simply impossible to deliver effectually filtered water until the new reservoirs are in use.

## CONTINENTAL UNION GAS COMPANY, LIMITED.

The Ordinary General Meeting of Shareholders was held at the City Terminus Hotel, Cannon Street, London, on Tuesday, the 14th inst.—H. M'LAUCHLAN BACKLER, Esq., in the chair.

The SECRETARY (Mr. E. Garey) read the notice convening the meeting, and the following report of the directors:—

Your directors have the pleasure to present their annual report, together with a statement of accounts for the year ending the 30th of June last.

Calling to mind the information afforded the shareholders at the last general meeting, your directors think it best to acquaint you with the principal passages of the report of the board of the *Union des Gaz*, unanimously adopted at the annual meeting of shareholders held in Paris on the 20th of last month, so that you may have a complete knowledge of the progress made and working during each year at their stations.

The report itself, with accounts, has been translated, and now lies upon the table. It may be seen, at any time, at the office, by shareholders who desire to inspect it.

The following are the extracts referred to:—

"We think it right to explain to you as usual the alterations which have taken place in the different accounts since the last balance-sheet, approved by the general meeting of Oct. 29, 1874, was prepared.

"*Outlay Account* amounted to 23,637,548f. 98c., to which has been added 772,719f. 15c. for new works, mains, purchases of land, &c., made during the last financial year, thus forming a total of 24,410,268f. 13c.

"The sum thus spent on capital account is divided amongst the stations as follows:—

"*Albi.*—New mains, services, new public lights, and additional benches of retorts.

"*Alessandria.*—New mains.

"*Beaucaire.*—New mains, and additions to the manager's house.

"*Cette.*—New mains, governors, and additional service-pipes.

"*Genoa.*—Mains, condensers, new boilers, new gasholder, exhauster, new retort-house, and additions to material of public lighting.

"*Milan.*—New mains, additions to material of public lighting, new condenser, and purchase of land for the second station.

"*Modena.*—New purifiers, mains, public lights, and additional service-pipes.

"*Nimes.*—New mains, and additions to material of public lighting.

"*Parma.*—Additional service-pipes.

"*Roanne.*—New mains and public lights.

"*Ruetl.*—Additional service-pipes and mains.

"*Strasburg.*—New mains, and additions to the material of public lighting.

"*Vienne.*—Mains and public lights.

"The whole of this outlay for works now terminated, as well as that for works not yet completed (and which we place separately under the head of 'Works in course of execution'), was rendered necessary by a considerable growth in the consumption of gas, which compelled us in some instances to increase the productive power of the stations, and in others to lay down additional mains for facilitating the circulation and distribution.

"The works in course of execution amount to 692,533f. 88c., but, not being completed on the 30th of June, could not be comprised in the outlay account, which will therefore not be charged with this expenditure until they shall have been entirely finished.

"The general working capital of the stations, which amounted to 2,484,943f. 33c., including the sundry debtors and creditors, has been increased by 463,524f. 41c., thus forming a total of 2,948,467f. 74c. This increase was required by a growing demand for gas, to meet which every branch of the service has had to be reinforced. This applies also especially to coals, the stocks of which on June 30, 1874, only amounted to about 14,000 tons, whereas on June 30, 1875, they were about 23,000 tons.

"*Redemption.*—You will bear in mind that in the preceding financial years the amount of the bonds annually drawn and paid off was included in the yearly charges of the undertaking, which allowed us to create a special redemption account, by means of which we were able to appropriate to the different stations the proper depreciations applicable to each, and thus bring the outlay accounts to their present value.

"The redemption account comprises this year the amount of the 1626 bonds drawn in November, 1874, which at the issue price of 220f. form a sum of 357,720f.

"The account, 'Statutory reserve,' amounts to 92,385f. 35c. This sum represents the 5 per cent. reserve, which, according to Article 41 of our statutes, we have to take from the profits, amounting for the past financial year to the sum of 1,847,707f. 20c.

"A large number of shareholders expressed their desire to receive a part of their dividend in the summer, and the board endeavoured to meet their wishes.

"The directors were able in the month of June to estimate approximately the profits likely to be realized during the entire year, and they took upon themselves the responsibility of distributing in July, on the shares both of the 1st and 2nd series, an interim dividend of 3½ per cent., less deduction for taxes chargeable to shareholders.

"The net profits shown by inventory amounting to 1,755,321f. 85c., this interim dividend absorbed 868,807f. 50c.; there remains, therefore, a sum of 886,514f. 35c. to deal with.

"We have the honour to propose to you—1. To approve this distribution made by us of an interim dividend of 3½ per cent. 2. To fix at 5½ per cent. the balance of dividend payable on the 20,000 shares of the first series, and at 3½ per cent. likewise the balance of dividend payable on the 30,000 shares of the second series, these latter in proportion to the amount paid on them—*i.e.*, on 13,593,900f.

"This division on the two series of shares will absorb a sum of 884,771f. 25c., and a small amount will remain to be carried to the credit of 'Profit and loss' new account.

"In concluding this report on the position of the company's affairs, we have the satisfaction to inform you that the working of the undertaking, which had in preceding years been prejudicially affected by the war and the rise in the price of coals, has now again entered upon its normal condition of prosperity and expansion."

Your directors have little to add to the statement from which the preceding extracts have been taken.

In addition to their large interest as shareholders in these works, the Continental Union Gas Company (as you are aware) are the proprietors of Messina and Montargis stations.

Your directors can report most favourably on the improvement in both during the past year, the returns from Messina having largely increased, without any important expenditure of additional capital.

At Montargis 400 mètres of new mains have been laid, and 725 mètres of defective mains replaced. A considerable reduction of leakage has thus been assured. An additional bench of seven retorts has also been provided, to supply the increasing consumption of gas.

Although coals have fallen materially in price, they cannot yet be obtained at the lowest rates formerly paid, and the value of coke having suffered considerably, in consequence of the lower cost of all descriptions of fuel, the full advantage of more favourable contracts for coals has hardly yet been realized.

The available balance of the year's general revenue account is £48,534 8s. 8d. Out of this sum an interim dividend at the rate of 5 per cent. per annum has been paid on the ordinary shares, and at the rate of 7 per cent. per annum upon the preference shares, for the six months ending the 31st of December last.

Your directors have now resolved to declare a dividend at the rate of 6 per cent. per annum on the ordinary share capital, for the six months ending the 30th of June last, free of income-tax, and for the same period, on the preference shares, at the rate of 7 per cent. per annum, leaving £2241 7s. 2d. to be carried forward to next account.

Your directors refer with deep regret to the loss the management of the company has sustained by the death of the late Mr. John Fisher, one of the original directors, who had constantly manifested the most lively interest in its success, and assisted its operations by his valuable advice. They have nominated Mr. T. Chaloner Smith to fill the vacancy, a gentleman in every way qualified for the office. As Mr. Fisher would have retired at this meeting, Mr. T. Chaloner Smith will now do so, but is eligible for re-election.

The retiring auditors are A. Hersee, Esq., and F. Tendron, Esq., and both being eligible, offer themselves for re-election accordingly.

The CHAIRMAN said: Gentlemen, in moving the adoption of the report and accounts, I shall not find it necessary to make any lengthened remarks, because the board have been so exceedingly anxious, in their report, to put everything before you in the most detailed manner, and to explain the position of the company as clearly as it was in their power to do, that really there is very little left for me to say. At the last meeting I endeavoured to explain the position of this company, and the improvements which had taken place in it. I stated then that it would be necessary that the annual meeting should be held at a later period than usual, and that the dividend would have to be deferred for some short time. I do not, therefore, think it necessary to travel over all that ground again. It must be evident, I imagine, to all the shareholders, that we had good reason for this. We took pains to send to our proprietors a statement, in print, of the proceedings which took place at the last meeting, and, therefore, every one connected with the company at that time is in possession of all the facts affecting its position. But some shareholders, I fear, could not have taken the trouble to read the printed statement I refer to, or we should not have received some of the extraordinary letters which have since been addressed to us. It is a little discouraging, when we have taken pains to put them in possession of the facts relating to the company, that some should treat so lightly our efforts, as probably to cast away in the waste-paper basket the statement we sent to them. I hope it will not be so in the future, but that all the shareholders will make themselves acquainted with the communications we make to them. You must, I think, see that it is rather to the interest of the company you should do so, than that points of great delicacy should be discussed at public meetings like this. You will observe, by the report just read, that we are enabled to give you an increase of dividend, to the extent of one per cent. more than was paid last year—that is, at the rate of 6 per cent. for the half year. I do not pretend to say that 6 per cent. is a very magnificent dividend for a gas company; but then, this is a growing dividend, and if we succeed in increasing it at the rate of one per cent. every year, we shall soon be on a par with most of the prosperous foreign gas companies. And though I do not raise a flag of triumph over that, I do say it is very satisfactory, considering the situation of the company in times past. You may not have been able to follow the figures that have been submitted by the secretary; and I observed that one shareholder, during the reading of the report, suggested that the French currency might have been converted into English. But you must recollect that that part of the report was merely a quotation from the report of the *Union des Gas*. We had no right to alter it, and we simply gave it as a translation of the French document. But if any shareholder wishes to go to the office and see the report itself, he can do so, and the secretary will tell him at once the value of the French figures in English currency. Of course, we have given you our own accounts, in the Continental Union Company, in English money; but we could not do it in reference to the French accounts, because a great deal depends upon the rate of exchange. It is better, therefore, that you should have the statement as it is, and you can make further inquiries at the office, if you desire additional information. You will, perhaps, have remarked in the reading of the report that the outlay has been considerable. There is no doubt that

that is so, and that we have not yet recouped the full advantage which we expected from it. At the same time we must take into account that we have exclusive privileges accompanied by conditions which we must be very careful to execute most punctually in every respect. In fact, we must deal liberally with the authorities on the Continent, with whom we come in contact. If we did otherwise, we should raise a feeling of hostility, which would damage us in many ways as we proceed in working these concessions. Some of this outlay, therefore, which is for public lights, is not very productive, but it is a necessary outlay, first, because we are pledged to make it by our concessions, and secondly, because it is useful in maintaining the good feeling which should always exist between us and the authorities. You are aware that we have had considerable reduction in the price of coal. I must say we hoped it would have proved more beneficial to us than it has been, and that instead of an increase of 1 per cent. in our dividends, we might have realized more. But, the average price of coke has fallen to within a fraction of the same sum per ton, so that the only benefit we realize is on the difference between the weight of the coal purchased, going into the retorts, and that of the coke withdrawn therefrom and sold. We have some advantage in the price of tar, but it is of no great importance. Nevertheless, upon the whole, I consider the results in the past year very satisfactory, and, what is more cheering still, I believe our prospects for the future are very good. I think it is opportune to state that our accounts for the past month, which we examined this morning, are more favourable than any others we ever received from the various stations of the company, and if they go on so, as I hope and believe they will, our improvement will be in a greater ratio than it has been for some time past. In fact, I consider that we are on the high road to prosperity. I see before me the faces of many friends who are connected with a similar undertaking to this, with which I also am associated. They know that that undertaking was not always so prosperous as at the present time—in fact, it was in a position not nearly so good as this—and they know also that it has been brought up to a state of the highest success. I, and some of my colleagues at this table, know exactly how it has been brought about, and we see our way to improve this concern as that has been improved, and we intend to do our best to bring it up to the same state of prosperity. Before I conclude, gentlemen, I feel that there is one other part of the report that I ought not to pass over without comment—I mean that part which refers to the decease of Mr. Fisher. By his death we have lost a valued friend on this side of the table, and the company have lost a most able adviser. In replacing him, some serious considerations presented themselves. Now the qualifications desirable in a director of this company, besides those applicable to all companies—that is to say, high standing, leisure time, and business habits—are experience in the manufacture and distribution of gas generally, but especially with reference to the supply of continental cities and towns; also a knowledge of the customs, and manners, and the languages of the countries in which we carry on our undertaking, and in carrying on which it is necessary sometimes to exercise the finest tact and greatest delicacy in handling questions which come before us, in order to avoid failure. It is not easy always to secure a gentleman who fulfils all these requirements, but I think, having succeeded in finding them in Mr. T. Chaloner Smith, we did right in appointing him to the vacancy at the board, and I am quite sure I shall have the meeting with me when I come to propose his re-election. In now moving the adoption of the report, I will only add that I shall be happy to hear any shareholder who desires to speak on the subject, and to answer any questions that may be put to me, so far as it is advisable to do so; and if there is any information which cannot be given here, it may be obtained at the office. I move—"That the report and accounts now read be received and adopted."

Mr. BLAKE seconded the motion.

A SHAREHOLDER: Shall we receive a printed report of the proceedings to-day?

The CHAIRMAN: Yes, we will send one to each shareholder.

The motion was put, and carried unanimously.

The CHAIRMAN: I now move—"That Mr. T. Chaloner Smith, who retires by rotation, be re-elected a director of the company."

Mr. WHITE: I beg to second the motion. I am quite sure we have in Mr. Smith the right man in the right place.

The motion was put, and carried unanimously.

Mr. T. CHALONER SMITH: Gentlemen, I return you my very sincere thanks for the honour you have done me in re-electing me, I might say almost—practically electing me a member of this board. I only wish I could feel I deserved the many kind expressions that my very valued friend, Mr. Backler, has been pleased to utter in connexion with my name. You and I know him too well, and appreciate too justly his sincerity not to believe that he would not have said a single word that he has said without fully believing and knowing it to be perfectly correct. Now, I think I am addressing a body of gentlemen who are thoroughly acquainted with business, and who, I am sure, will be far better pleased if I abstain from saying anything more than that I thank you very much for the honour you have done me in electing me a member of the board, and I can say no more and, perhaps, ought not to say less than that I shall endeavour, so long as I remain a director, to discharge the duties imposed upon me to the best of my humble abilities.

The retiring auditors, Messrs. Hersee and Tendron, were re-elected.

The CHAIRMAN, in answer to an inquiry, said the dividend would be paid on the 4th of January.

On the motion of Mr. STOKES, a cordial vote of thanks was given to the chairman and directors for their able management of the company's affairs.

The CHAIRMAN, in acknowledging the vote, said: On behalf of my colleagues and for myself I beg to thank you for this expression of your approbation, and to assure you that we shall, as we have in the past, use our best endeavours to promote the interests of the company, and permanently to establish its prosperity.

The proceedings then terminated.

## LEEDS CORPORATION GAS SUPPLY.

### REPORT OF MR. HENRY WOODALL ON THE QUALITY OF THE GAS FOR THE MONTH OF NOVEMBER.

The following report was presented to the Gas Committee of the Corporation of Leeds on Thursday, in accordance with a resolution passed at a previous meeting:—

Mr. Chairman and Gentlemen,—I beg to report that, during the month ending the 30th of November, the quantity of gas made at the various works has been as follows:—

| | |
|---|---|
| Meadow Lane | 70,427,000 cubic feet. |
| New Wortley | 42,761,000 " |
| York Street | 15,642,000 " |
| Total | 128,830,000 " |

The increase over the corresponding period of last year—which is very slight, owing to the exceptionally clear weather, and the depressed condition of various trades—amounts to 2,231,000 cubic feet, or 1·8 per cent. Throughout the month there has always been an abundance of gas in stock, and maximum pressures have been maintained at the gasholder stations.

In accordance with the desire of the committee, I have earnestly directed my attention to the removal of complaints as to limited supply; and with that object I have laid 900 yards of 8 inch mains, in lieu of 4-inch, from Kirkstall Road to Hyde Park Road (Henrietta Street), and 158 yards of 6-inch, in lieu of 2-inch, in Basinghall Street. I am at present engaged in laying an 8-inch main across Woodhouse Moor, in place of a 4-inch, which, when completed, will, it is hoped, supply all the requirements of the Headingley district.

In addition to the foregoing, 1020 yards of 3-inch and 4-inch mains have been laid during the month (chiefly in the Roundhay district), to meet the requirements of new customers. Pipes ordered for renewals in Hunslet are now coming to hand, and with the commencement of the new year I shall be in a position to begin the laying of a 12-inch main to Chapeltown.

The net increase in the number of gas consumers during the month has been 113. Having ascertained that in a vast number of cases—not fewer than 2000—the meters in use are too small to pass the gas required except at extravagant pressures, I am causing such meters to be removed, and larger ones fixed instead, with, generally speaking, satisfaction to the parties interested.

It will be seen by the magistrates gas examiner's report that the average illuminating power of the gas supplied during the month has been equal to 17 candles. With gas of this quality, which is superior to that supplied to most of the towns in England, there ought to be a sufficiency of light, and feeling assured that the burners commonly in use were largely to blame for the dissatisfaction which has recently been expressed, I have tested a variety, with the following interesting results:—

| | Per 5 Feet per Hour. |
|---|---|
| London Argand 27 holes | 18·06 candles. |
| Christiania (regulated) | 15·22 " |
| Börnner (wide cut batswing) | 16·41 " |
| " fine " | 11·93 " |
| No. 3 tulip burner, very commonly used in Leeds | 5·25 " |

The waste of gas here shown is enormous, the difference between the best and worst results being 12·81 candles, more than 60 per cent.

The subject of burners is of such importance to the gas consumer that I shall be glad to receive from the committee permission to exhibit in the windows of our central offices a number of specimens, with the object of showing the public the importance of exercising judicious care in their selection, every quality of gas requiring to be burnt under certain conditions for the full development of its illuminating power, and thus a burner which is suited for 12 or for 20 candle gas may be, and generally is, quite unsuited for such as that uniformly supplied under your direction.

HENRY WOODALL, Gas Engineer.

Permit me to say that the tests I have given are of burners which happened to be in my possession at the time. There are many other descriptions equally good as several in the list, while no doubt there are many in use inferior to the worst. I purpose making experiments over an extended variety, which I shall be happy to report upon at another opportunity.

## MANCHESTER CORPORATION GAS AND WATER-WORKS OFFICES.

Speaking of the approaching completion of the Manchester new Town-Hall, in which all the municipal business will in future be conducted, the *Manchester Examiner* refers to the inconvenience hitherto sustained through the various departments being scattered over the city, and says:—"The numerous ramifications of business, which have extended with the progress of a prosperous city, and have long since outgrown the old establishment which served our Town Council, in its day of small things, before corporation gas and water-works were thought of, will now be under the better control of their one organization, owing to their accommodation within one building. The water department forsook its old premises at the back of the present Town-Hall some months ago, and entered a convenient suite of rooms on the Princess Street side of the new building, while as yet the masonry of the tower was incomplete. This week, almost simultaneously with the placing of the crowning stone of the edifice, the gas department have taken possession of a different suite of rooms, and have thus borne testimony to the progress in the interior of the building.

"It will hardly be surmised that the total number of servants for whom accommodation was needed in different parts of the gas offices in Albert Square was not short of 90, and in the water offices at different parts of the town there are close upon 100 servants, who will ultimately have their head-quarters in the new Town-Hall. The offices of the gas department in Albert Square for which the corporation have paid a rent of about £350 a year, were deemed palatial when they first entered them some seven or eight years ago; but the growth of the department has long since rendered their accommodation utterly inadequate. An old citizen remembers the time when the whole of the work of supplying the town with light, including the lighting, which is now a separate department not managed for the gas offices, was managed from a small room in Police Street, of which the rent of £30 was then deemed exorbitant. Since 1843 the meters hired to the public have increased from 7000 to 67,000. In the last ten years, the gas transmitted from the works to consumers has increased from 1070 million cubic feet to 1778½ million. The length of pipes laid had increased in the same period from 329½ miles to 518½ miles. This vast increase of work indicates a proportionately great amount of clerical work thrown upon the offices, and as the annual ratio of increase of gas consumption is nearly 7 per cent., this office work increases year by year. For this work the gas department have now abundant space on the Lloyd Street side of the new Town-Hall. For the present the public enter by the Cooper Street entrance, and on the left, along the vaulted window, are arranged a sub-committee room, superintendent's room, an office for the superintendent's clerks, the chief inspector's offices, and the rental and inquiry office. The last-named room is divided into sections by two richly-moulded arcadings, supported by polished granite shafts with carved capitals. The ceiling is panelled on a geometrical design. From this room an oak staircase communicates with other rooms on the floor above, occupied by the accountants and collectors. Still higher in the building seven rooms are at the disposal of the street-mains section of the gas department, and on the basement there are also seven rooms for the inspectors, the meter stores, &c.

"While referring to the work of the gas department, it may be interesting to readers to learn that some deficiency in the quality of the town's gas that may have been recently noticed is not to be taken as indicating any probable partial failure in the gas supply. The experience of last winter is not at all likely to be repeated this year, the corporation having large supplies of coal to meet the winter's demand. An accidental suspension of the purifying material affected the quality of the gas for a few days last week; but the Gas Committee do not anticipate any unusual difficulty in the present winter.

"The water department has been located since July in the new Town-Hall, their need for better accommodation being even more pressing than that of the Gas Committee. Within the last 20 years the population supplied with water by this department has increased from 300,000 to 800,000, and as showing the better work done by the department in inspections, &c; the average daily supply per head is now only 21 gallons, as compared with 23 gallons 20 years ago. The Corporation of Manchester supplies water by meter to a larger extent than all the London companies put together. The average daily water supply indicated by the books of the water department is now 16¾ millions, or more than double what it was 20 years ago. The office business involved in this supply is now carried on with much more freedom and comfort than formerly in the rooms allotted to this department in the Princess Street side of the new Town-Hall. They have already 12 commodious and well-lighted rooms, the rental room being of an ornamental character similar to that in the gas department, and the whole of the basement on the Princess Street side will soon be at the disposal for the pipe-layers, testers, and stampers, and for the stores. The Albert Street front and a large portion of the rooms on both corridors leading towards it are still occupied by workmen only."

## RICHARDS'S WATER-METER.

The engraving fig. 1 represents the elevation of a water-meter constructed and recently patented by Mr. W. Richards, the inventor of the dry gas-meter. This invention is capable of being employed for either high or low pressure, and consists of a cylindrical vessel closed at the ends, the upper and lower parts, in the model from which the drawings were made, being of glass, to show the action of the instrument. Fig. 2 is a section of the same.

Within the cylinder are two flexible diaphragms, of prepared india-rubber, the form resembling the circular forge bellows: these are somewhat smaller in diameter than the outer case, for the purpose of preventing them from rubbing against the latter, thus avoiding the wear and tear from friction at those parts. One extremity of each diaphragm is hermetically secured to the outer case (as shown in section, fig. 2), so dividing this into three distinct compartments, Nos. 1, 2, and 3. To the other end of the diaphragms are attached the plates, *d d*, which are of larger diameter than the diaphragms, in order to keep the latter clear of the case, yet of such dimensions as to work with freedom within the cylinder. The plates have openings around their circumference, to allow the water to pass with all facility to and from the chambers Nos. 1 and 2, and are provided with lugs to guide them in the same plane.

A central shaft, *e* (fig. 2), is provided with two cranks, placed at an angle of about 120° to each other, and revolves freely in a suitable bearing at one end, its other extremity passing through a stuffing-box, and protruding through the seat and cover of a rotary valve, which is preferred for this description of meter. To the end of the shaft is fixed a carrier, *k*, which gives motion to the valve-cover. To each of the cranks is attached its corresponding connecting-rod, which are connected to the joints, *h h*, affixed to their respective plates or pistons.

Fig. 3 represents the seat of the rotary valve, through which the shaft *e* passes at the centre. The outer ring of orifices communicates with the chambers indicated by the respective numbers. The inner ring of passages corresponds with the outlet. All the bars of the valve-seat, except the short cross ones, are constantly covered by the cover of the valve, so that no dirt can possiby accumulate upon them.

Fig. 4 is a plan of the valve-cover, which corresponds with its seat; *i* is the inlet, and *o* is the outlet. Fig. 5 is a plan of the square frame in the centre of the meter, the index being removed, showing the cover of the valve on its seat, together with the carrier, K, affixed to the shaft, *e*, which conveys motion to the cover, and so controls the ingress and egress of the water to the various compartments of the meter.

The action of the instrument is as follows:—The water, entering by the inlet-pipe, passes through the valve into one of the three chambers, and expels at the same time a like quantity of water from one of the other chambers, which is in communication with the outlet passage of the cover of the valve. This action is continued until the diaphragm of the filling chamber is distended to its limits, when its corresponding crank will be on the centre, and the passages of ingress and egress to the chamber are closed. During this operation the second compartment will come into action, and subsequently the third, both acting in like manner to that described. Thus all the various chambers will receive and eject a quantity of water, according to the capacity of the diaphragms.

As represented in engravings, the water is entering the centre compartment No. 3. The lower diaphragm is filled to its limits; its inlet and outlet passages being closed, and its crank on the centre inoperative.

The upper diaphragm is filling, and expelling the water from chamber No. 1, and in this operation opens simultaneously the passage admitting the water to

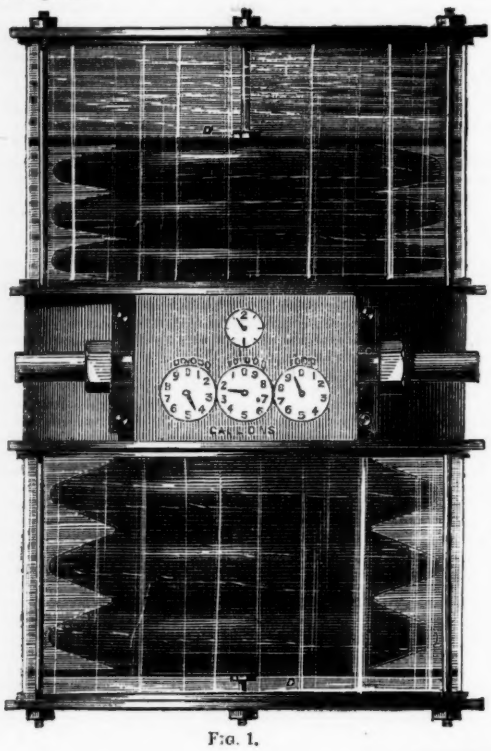

Fig. 1.

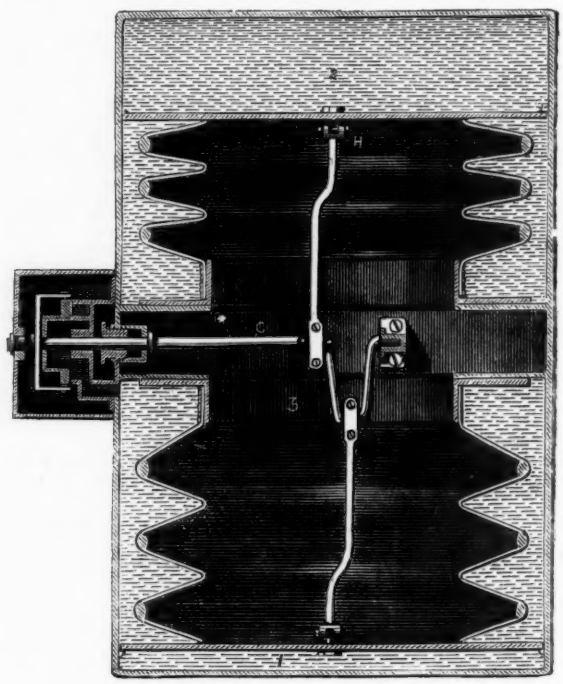

Fig. 2.

Fig. 4.

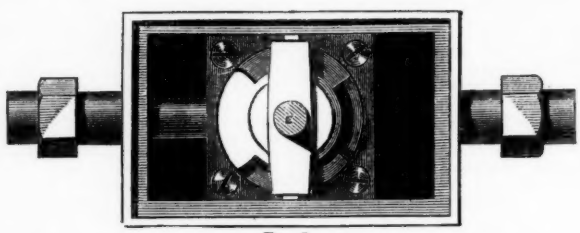

Fig. 5.

Fig. 3.

chamber No. 2, and the passage from chamber No. 3, whence the water issues. This action continues until the upper diaphragm is filled, after which the inlet of chamber No. 1 is opened, when both diaphragms expel the water from chamber No. 3, until the lower one is emptied or collapsed. This effected, the inlet to chamber No. 3 and outlet to chamber No. 2 are opened, and the water enters the lower diaphragm, and expels a like quantity from chamber No. 2.

Thus the diaphragms are distended and collapsed alternately, receiving and expelling a quantity of water equal to their capacities, so giving a regular and continuous supply.

Thus, at each revolution of the shaft, a definite quantity of water will be received and delivered, and as the range of the flexible material is controlled by the cranks, it is obvious that this quantity cannot vary. Hence the capacity of each revolution of the shaft being known, the continuous action of the meter is recorded on a dial by suitable gear-work, as is well understood.

In order to prevent any undue strain on the flexible material, the cover of the valve is always so arranged as to have "the lead," or to close the ingress to any chamber immediately before its corresponding crank arrives at the centre, and when this is attended to, no matter whatever may be the pressure on the meter, whilst the supply is limited to its capacity, the flexible material will not be affected by it.

The material employed by preference for the diaphragms is the red india-rubber, the durability of which has been confirmed in a remarkable manner by its application in the manufacture of tobacco pouches, and that article used in the toilet known as the emollient, and various other articles. Whereas although, in the case of the tobacco pouch, the india-rubber is continually brought in contact with its greatest antagonist—namely, grease, which impairs its elasticity, in the adaptation of this material to the water-meter, the very opposite result to this is attained, as water is well known to be the great preservative of all kinds of prepared india-rubber, and for that purpose it is employed by manufacturers who desire to keep articles of that material for any lengthened period.

In order to prevent any undue supply from the meter, much beyond the quantity for which it is constructed, an india-rubber lip-valve is placed at the outlet, which closes with any extraordinary pressure.

Among the other points of recommendation to this meter are, firstly, the very low pressure required for its action, as it is set in motion by a column of water of 3 inches only; consequently, water measured by it can attain almost the height of the source whence it comes. It measures all quantities, from the smallest dribble to the full supply for which it is estimated, whether this may be 200 or 20,000 gallons per hour. It is not susceptible of derangement by the accumulation of grit upon its working parts. It is very cheap in its construction, and there is reason to believe, from the experience acquired of the character of red rubber, particularly in contact with water and in the absence of friction, that its durability will be greater than that of any other meter in use. Its form permits of it being enclosed within a case lined with any suitable non-conducting material, as felt, sawdust, &c., at a very moderate cost, thus preventing the interruption and injurious action of frost upon the meter. It is therefore capable of being applied in all descriptions of localities, precisely as the gas-meter, and with the same assurance of all the fluid passing therethrough being accurately registered.

The inventor proposes also, when desirable, to construct the meter with one diaphragm only, and an ordinary slide-valve, in which case the plate or piston is fixed to a central rod, which passes through a stuffing-box. At the end of the rod is fixed a button, which, acting on a bent lever, at the end of each stroke gives motion to the cover of the valve, and permits of the ingress and egress of the water to the respective chambers.

## IRON AND COAL TRADES OF SHEFFIELD, SOUTH YORKSHIRE, AND NORTH DERBYSHIRE.

(FROM OUR OWN CORRESPONDENT.)

Again I have to report that the past week has brought no material alteration in the condition of the local iron trade, in addition to which it appears impossible to predict any improvement after the Christmas holidays have terminated. There are those who say that they feel confident that an immense amelioration of the existing dulness will of a certainty come about during the earlier months of 1876, and that we shall in all probability enjoy a moderately good trade again by Midsummer. Others, on the contrary, and apparently with much more reason on their side, point out that before any great revival can possibly take place there must be a great reduction in the price of fuel, and the ironworkers wages in this locality must be lowered to an extent which will in that respect place their employers on the same footing as the Staffordshire masters. At present, to deal only with strict facts, there is every indication of the holidays being unusually prolonged this year, and, if rumour be true, we shall have rather serious troubles at the outset of the new year.

During the week there have been a number of sales of pig iron, prices being steadily firm, but with a reported disposition on the part of vendors to negotiate specially for future deliveries. The agents of the North of England firms now quote about the following nominal figures:—No. 1 foundry, 54s.; No. 2 foundry, 52s.; No. 3 foundry, 50s.; No. 4 foundry, 49s.; No. 4 forge, grey, 49s.; No. 5 forge, mottled, 48s. 6d.; No. 6 forge, white, 48s.; refined metal, 69s.; Kentledge, 57s. 6d.; and cinder pig, 39s. 6d., net cash.

There is at present a good demand for all kinds of fuel, which, from one or other cause, is not in such abundant supply as it has been. Gas coal is being vended at 8s. to 11s. on contracts, but at an average 9s. 6d. to 10s. may be taken as the current figures. Household coals are 1s. dearer. Breeze coke is 10s., hard washed melting coke 18s., and unscreened slack 3s. per ton at the pits. On Monday last, the 13th, the Sheffield United Gaslight Company advanced their gas coke 10d. per ton, making large and soft washed breeze 14s. 2d. per ton.

## IRON AND COAL TRADES OF SOUTH STAFFORDSHIRE AND EAST WORCESTERSHIRE.

(FROM OUR OWN CORRESPONDENT.)

Operations in the iron trade have again been chiefly characterized by increasing dulness, alike in the pig and finished departments. The demand grows more sluggish from week to week, and transactions are strictly limited to the satisfaction of immediate requirements. Although South Staffordshire has not yet felt the depression so seriously as some of the northern iron-making districts, yet there is little doubt that much distress will be experienced by the ironworkers here, unless an improved condition of things is shortly established.

Rates are generally firm, owing to the condition of the coal market. Indeed, prices on the present standard are declared to be quite unremunerative. The leading demand is still for plates and sheets of noted brands, for which there is a moderate inquiry, but in all other departments of the trade specifications are very scarce.

In pig iron the market is upheld by the curtailment of production. The make has been further restricted this week by the blowing out of the furnaces of the Parkfield Iron Company. Prices range from £2 17s. 6d. to £6 per ton, according to quality.

Best coal continues in steady demand, and in the Cannock Chase district prices of coal and slack have this week been advanced 1s. and 6d. per ton respectively. The current demand runs chiefly upon household and railway qualities. In the Wolverhampton districts, too, owing to the submergence of many of the collieries, prices have advanced in some cases to the extent of 6d. per ton, but the advance is believed to be only temporary, as the condition of the iron trade will shortly have the effect of bringing down prices of all classes of fuel, but for the present local manufacturers are much inconvenienced by the diminished output, and the railway and canal traffic is at this season so heavy as to preclude the hope of obtaining any substantial relief from other districts.

Around Stourbridge the makers of fire-clay goods report a good demand in anticipation of next season's export trade, and the specifications of home gas companies are also coming in pretty freely. It is announced that one or two of the leading manufacturers intend to exhibit specimens of their produce at the forthcoming Philadelphia Exhibition.

## THE LANCASHIRE COAL AND IRON TRADES.

(FROM OUR OWN CORRESPONDENT.)

The best qualities of coal used for household purposes continue to stiffen in price, and small advances have, during the last few days, been made at some of the collieries. Stocks are now generally very light, and a few of the best seams are rather scarce. For gas coal there is also a continued good inquiry to cover short contracts, and prices remain firm at those last quoted. In some cases there has been a little more inquiry for engine classes of fuel; but, generally, this branch of the coal trade continues quiet, and prices are weak.

In the Manchester district there is some talk of an advance in the pit prices for house coal at the end of the month, as the advance made at the commencement of this month only applied to the delivery rates. The leading firms, however, have not yet decided to take any general step in this direction.

In the shipping trade colliery proprietors are asking rather higher prices for good Lancashire steam fuel; but these are difficult to obtain, as buyers seem disposed to cover their requirements elsewhere, rather than pay the advanced rates.

For coke the demand continues very dull, and this class of fuel is a complete drug in the market.

The iron trade of this district continues very dull, and buyers are exceedingly few. The expectation among consumers appears to be that present prices cannot last, as there is not sufficient work to justify them. The majority of the ironfounders complain that they have exceedingly few orders on their books for next year's delivery, and they do not feel disposed to buy until they secure more work. Manufacturers are very quiet, and are easier in their prices for bars.

The quotations are about as under:—Lancashire pig iron, delivered in the Manchester district, 62s. 6d. for foundry, and 61s. for forge; Middlesbrough, 58s. 6d. for No. 3 foundry, 58s. for No. 4 foundry, and 57s. 6d. for No. 4 forge for early delivery, but for forward delivery prices are not so firm. Staffordshire bars delivered in the Manchester district are quoted at £8; Lancashire, £7 17s. 6d.; Middlesbrough, £7 15s. per ton; heavy rails, £7 5s.; and light ditto, £7 15s. per ton.

## THE COAL AND GENERAL TRADE OF THE NORTH OF ENGLAND.

(FROM OUR OWN CORRESPONDENT.)

During the early part of last week there were good arrivals of handy coasters in the northern coal ports. They were immediately taken up to load house and gas coals. They had ready turns, and were paid a high rate of freight. There have been more arrivals since, and the merchants who were the most in need of ships having had their immediate requirements met by the first fleet of vessels which came to hand, freights have fallen about 1s. per ton to London, and 10s. per keel to the British Channel. Loading turns are now about seven days, and it is anticipated that there will be a sufficient supply of coasting tonnage to meet all the requirements of the trade until the end of the year.

Very few additional contracts for gas coals have been reported within the past ten days. The best gas coal trade is not quite so firm, and a number of the second-class gas collieries are doing very badly; many of them are not working more than half time. Second-class gas coals may be bought at 8s. per ton, and under. A few contracts were made last week to ship coking coals to the Continent next year, but at extremely low rates. The household coal trade is doing moderately well; there is no excess of business, however, but current rates are fairly maintained. The steam coal trade shows no improvement. In this trade, and in the manufacturing coal trade, coals may be bought at a great variety of prices. The pits are working from four to six days per fortnight, and even with this limited vend a market can hardly be found for the coals. At the end of this week the Christmas holidays will begin, and there will be a good deal of irregularity in the coal trade for a fortnight after that.

A little more confidence was manifested in the iron trade last week. There were somewhat better shipments of manufactured iron, and the ironmasters did not take such a desponding view of the prospects of the trade. Destitution is very prevalent amongst the ironworkers of Cleveland and in some parts of Tyneside, but there is a sort of confidence manifested that the tide is at its lowest, and that with the turn of the year a better business will be done.

The general manufacturing trade of Tyneside continues in a dull, languid state. The chemical business seems to get worse every week, and manufacturers state that they are losing money upon every ton of soda they make. Foreign merchants are buying up chemicals pretty freely, and there are also very fair shipments of chemicals to London, but it does not improve business. The fire-clay goods trade is quiet at present, and shipments to London are limited.

## TRADE NOTES FROM SCOTLAND.

(FROM OUR OWN CORRESPONDENT.)

It is evident that the Town Council of Edinburgh and their gas analyst are not disposed to rest satisfied with the quality of the gas supplied to the city by the Edinburgh and the Edinburgh and Leith Gas Companies. The subject was again brought up at a meeting of the council during the past week, at which the public analyst submitted another report. He stated that the gas supplied to the city by the Edinburgh Gas Company on Wednesday, the 8th inst., had an illuminating power of 30·38 candles, and that supplied by the Edinburgh and Leith Gas Company was of 27·92 candle power. Traces of ammonia were found in both. Councillor Sloan urged that the Edinburgh and Leith Company should be called upon to bring the quality of their gas to the Edinburgh Company's standard; but on the suggestion of the Lord Provost it was agreed to give them a little more time, as they seemed to be improving their gas.

At the last meeting of the Town Council of Rothesay, the Gas Committee reported that there had been a decrease in the quantity of gas manufactured during November, as compared with the corresponding month last year; but the difference was accounted for by the improved system of lighting. On the recommendation of the committee, it was resolved to reduce the price of gas to 5s. 10d. per 1000 cubic feet, and that when the accounts were paid within 14 days, discounts should be made as follows:—On accounts of £20 and upwards, 5 per cent.; £10 and upwards, 4 per cent.; under £10, 2½ per cent.

Feeling, doubtless, that, as being the largest consumers of gas in Dundee, they have a great interest in noting its quality, the Police Commissioners of that town resolved at their meeting, held a few days ago, to appoint Mr. P. Anderson, the convener of the Police Committee, and Superintendent Mackay to test, from time to time, the illuminating power of the gas supplied to the town. It has been wisely recommended that care should be taken to have the photometers in the town, and at the gas-works, of precisely the same construction, so that there may be no conflict as to the data on which the calculations are made.

It has lately been urged, in one of the Glasgow newspapers, that some effort should be made towards having the Corporation gas analyzed and reported on, say, monthly. A correspondent suggests that there is yet considerable room for improvement in the quality of the gas. Having had very dull light lately, and thinking it might possibly be due to water in the pipes, he set tradesmen to examine and clean them. They found, to their surprise, he says, along with other impurities, the pipes almost choked with ammonia. I fear they have been astray in their chemistry; possibly the deposit which they met with was naphthaline, or some other solid hydrocarbon, in a more or less impure state.

It is stated that the sum of £35,000, required for the purchase of the Inverness Gas-Works by the Police Commissioners of that town, to be raised by bonds, bearing interest at the rate of 4½ per cent., has been more than made up by applications exceeding the amount required to the extent of nearly £12,000. No allotments have yet been made. The prevailing opinion is that the division should be made among as many local applicants as possible, and that applications for large amounts should have no preference. The Caledonian Bank intimated their willingness to take £10,000 worth of the bonds, while a few private individuals asked for proportionately large amounts. The Police Commissioners have notified to the gas and water company that the purchase price will be paid and the works taken over on the 31st current, so that the new arrangement may begin with the new year.

A special general meeting of the Elgin Joint-Stock Water Company was held a few days ago, when the chairman explained at considerable length all the proceedings of the directors and their negotiations with the Police Commissioners, and laid before the meeting the offer made by the Police Commissioners to the water company, along with the condition on which the directors agreed to recommend the shareholders to accept the said offer. It was unanimously agreed to approve of the conduct of the directors in their negotiations with the Police Commissioners, and to accept the offer made by them.

The Craigluscar water scheme for the town of Dunfermline does not yet seem to have got its quietus; its promoters lately appeared by deputation before the Town Council, and, in presence of the deputation, Provost Mathieson made an elaborate statement, dealing with the whole question of water supply, and pointing out what he considered to be the inadvisability of putting any further dependence upon the resources of Craigluscar. After the retirement of the deputation, it was unanimously agreed that both the petitions presented to the council on water supply be remitted to the Water-Works Committee to scrutinize and report to the council on the following points—namely: 1, the number of ratepayers who have signed each petition; 2, the gross annual value of the property in respect of which each class of petitioners is rated; 3, the number of non-ratepayers who have signed both petitions; 4, the gross annual value of the property in respect of which those who have signed both petitions are rated. It is stated that the signatures to the petition for the Glen Devon scheme were 2160, and to that for Craigluscar 2334, while the total number of ratepayers is only 3500. In a few days a report upon the Craigluscar capabilities may be expected from Mr. Hawksley, C.E.

The proposed water scheme for the middle ward of Lanarkshire, as lately devised by Mr. Gale, C.E., Glasgow, was under the consideration of the local authority of the parish of Cambusnethan last Tuesday. Considering that the town of Wishaw, which forms the principal part of the parish, has an abundant water supply, and has, therefore, resolved to reject the scheme, the local authority resolved not to entertain the scheme. Uddingston and Bothwell will now have to look out for themselves.

The Parochial Board of Campsie, as the local authority, will meet on the 28th inst. to receive, consider, and determine upon a report which has been received from the board's engineers relative to the proposed water supply for Lennoxtown, with the view, if approved of, of commencing operations as early as possible in the ensuing year.

Messrs. Hawksley and Harrison, civil engineers, London, have made their inspection of the Lintrathen Water-Works. They were engaged on the work

three days, and on each occasion they had both the hydraulic and hydrostatic pressures applied. On the third day there was another burst, but not until the hydrostatic pressure had been fully on for about 50 minutes. Both Mr. Hawksley and Harrison were of opinion that the burst-pipe gave way in consequence of being defective in casting. It was taken out at once and replaced, and the water put on with as little delay as possible.

Prices in the Glasgow pig-iron market have ranged during the past week 63s. and 62s. 3d. cash, closing on Friday at 62s. 6d. cash for sellers, and buyers offering 1½d. per ton less. The market was quiet the whole week.

The coal market has been busy, but without any special features. With the customary pressure at this season of the year, the shipping trade will be kept busy till the close of the month. Prices are in some instances rather firmer. Several large quantities of gas coal have recently been shipped from the Clyde and from the Fife ports.

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NEWPORT (ISLE OF WIGHT) WATER SUPPLY.—The Newport and Carisbrooke Water Company having offered to sell their works for the sum of £8500, a special meeting of the Newport Town Council has been held to consider the proposition.

REDUCTIONS IN THE PRICE OF GAS.—The London Gaslight Company are about to reduce the price for common gas in their district to 3s. 6d. per 1000 The Andover Company will make a reduction of 1s. per 1000 on the 1st prox. The Corporation of Birmingham Gas Committee have given notice that from and and after the 1st prox., the price of gas will be reduced to 3s. 3d. per 1000 feet, subject to a discount of 5 per cent. if paid for within the second month of the quarter.

A FOOLISH PROCEEDING.—It is stated that a summons has been issued against the Hampton Wick Local Board by the Thames Conservators, to recover £94,000 for penalties incurred during 1890 days, at the rate of £50 a day, for failing to divert their sewage from the river.

BEVERLEY CORPORATION GAS-WORKS.—The Town Council of Beverley, having received a demand from the War Office to supply gas to the new barracks, have resolved to apply to the Public Works Loan Commissioners for a loan of £3000, repayable by instalments, to enable them to lay down the necessary mains, and to enlarge and improve their works. It was stated at the last meeting of the council that the annual consumption of gas was now about 90 million cubic feet, as against 10 million in 1856.

MARKET BOSWORTH GAS SUPPLY.—The inauguration of new gas-works for the supply of this town took place on the 10th inst., when the directors and shareholders of the company, with their friends, dined together to celebrate the interesting event. Mr. Surl, the manager of the gas-works at Hinckley, was charged with the superintendence of the erection of the buildings and laying of the mains in which he appears to have given great satisfaction. Messrs. Langton and Sons, of Enderley, were the contractors for the buildings, and Mr. R. Dempster, of Elland, for the ironwork &c.

DEFICIENT WATER SUPPLY AT DUDLEY.—At the Dudley Special Sessions, held on the 13th inst., the South Staffordshire Water-Works Company were summoned for having neglected to supply two of the residents with sufficient water on the 27th ult., they not being prevented by frost, unusual drought, or other unavoidable cause or accident, or during necessary repairs. After an inquiry extending over four hours, the magistrates dismissed the case, being satisfied that the cause of failure arose from circumstances beyond the control of the company.

WALSALL GAS SUPPLY.—At a special meeting of the Walsall Town Council on the 13th inst., to seal petition to Parliament for a new local Act, including power to purchase so much of the undertaking of the Birmingham and Staffordshire Gas Company as relates to the supply of gas within the borough, the Mayor (Mr. Chalkley) proposed the adoption of a recommendation of the Gas Committee, that the ratepayers of the outlying districts should be admitted to participation in the benefits arising from the gas-works on payment of £7000 (instead of £9300, which had been originally proposed), such sum to be paid by an extra charge of 6d. per 1000 feet of gas supplied to all new consumers in the outlying districts. Alderman Brownhill seconded the proposition, which was unanimously agreed to.

TRURO WATER SUPPLY.—The promoters of the bill which received parliamentary sanction last session, for supplying the town with water, have, we understand, entered into a provisional contract with Mr. George Bower, of St Neots, Hunts, to complete the works which are considered necessary to supply the town with water, for, in the first instance, the sum of £13,893. Of this amount the contractor agrees to take £4000 in shares. He also undertakes to pay interest at 5 per cent. per annum on the subscribed capital during the construction, and to continue the payment for one year at least after the completion of the works. The population of Truro is estimated at between 11,000 and 12,000, and the rateable value of the borough is £26,458.

PRINTING INK FROM GAS TAR.—The *Journal of the Society of Arts* says:—"Two French chemists, MM. Persoz and Jeannolle, have taken out a patent for making ink for letterpress printing, lithography, and autography from the refuse of the gas-works, from other tar, and the heavy oils of petroleum, resin, wood, &c. The inventors say that these substances present valuable qualities for the purpose, that they mix readily with lamp black and other dry colours in powder, and that the ink made from them has the grand advantage of neither penetrating the paper nor spreading, and, lastly, that it may be mixed in any desired proportions with the fatty oils for certain classes. For black ink for typographic printing the inventors use what they call evaporated tar, or liquid pitch, with lamp black and Prussian blue in the following proportions:—

| | |
|---|---|
| Tar | 100 parts. |
| Lamp black | 36 ,, |
| Prussian blue | 10 ,, |
| Glycerine | 10 ,, |

For coloured inks they use the heavy oils, purified as far as possible from the tarry matters, which give a brown tint, with the colouring matter in powder."

EFFECT OF AMMONIACAL LIQUOR UPON LEAD PIPE.—At the meeting of the Manchester Literary and Philosophical Society on the 2nd ult., Mr. P. Spence, F.C.S., &c., exhibited a piece of 2 to 3 inch lead pipe, in which the metal had been entirely transformed into galena, the crystallization being visible through the whole of the specimen. The shape of the lead pipe was unaltered, showing that the lead had not been exposed to a melting heat; no increase of bulk was visible, but the pipe was so brittle as to shiver with a blow. The circumstances in which this change was effected, as nearly as can be made out, were as follows:—The pipe had been used for the conveyance of ammoniacal liquor, and was sunk underground. It was in the vicinity of a furnace which heated the ground where it lay. It had been disused for some years, but never taken up. When the ground where it lay had to be excavated for a new erection, it was found that there had been a considerable leak of gas liquor, as the ground for some space was impregnated with ammoniacal salts. About 25 per cent. of the ammonia in gas liquor being sulphide, and the ground being warm, a constant atmosphere of sulphide of ammonium would surround the pipe, and this seems to have been the cause of the conversion of the lead into sulphide, as only that part of the pipe which was in the vicinity of the leak was found to be transformed.

HULL GAS SUPPLY.—Mr. James Baynes reports that, with one exception, the gas supplied to the district of Sculcoates and Myton during November by the British Gas Company was of satisfactory illuminating power On Saturday, November 27th, for a few hours, it went down to 13½ candles. Free ammonia and sulphuretted hydrogen were at no time present to the ordinary tests. The results for the month are—

| | Max. | Min. | Mean. |
|---|---|---|---|
| Illuminating power standard sperm candles | 16·50 | 13·56 | 15·91 |
| Grains of sulphur per 100 feet | 30·00 | 26·00 | 27·60 |

Mean barometer and temperature in experiment-room:—Bar., 30·00; tem., 55°.—Mr. James Baynes, jun., reports that the gas sent into the east district by the Sutton, Southcoates, and Drypool Gas Company during November was of good illuminating power. The sulphur impurities were low. The results for the month are—

| | Max. | Min. | Mean. |
|---|---|---|---|
| Illuminating power standard sperm candles | 16·78 | 15·95 | 16·43 |
| Grains of sulphur per 100 feet | — | — | 6·35 |

Mean barometer and temperature in experiment-room:—Bar., 30·45; tem., 53°.

LIGHTING COMMON STAIRS IN DUNDEE.—Sheriff Cheyne recently gave his decision in a case in which compensation was sought for personal injury through falling down a stair, which it was alleged was lighted in accordance with the requirements of the General Police and Improvement (Scotland) Act, 1862, and the Dundee Police and Improvement Act, 1871, provided the means of having the stair lighted. With his decision the sheriff made the following statement:—"Since last court day the clauses of the Lindsay Act, which I am asked to construe, have been brought under the notice of the High Court of Justiciary, in an appeal from Ayrshire, and it has now been authoritatively decided—and I think most correctly—that, under the wording of the clauses in question, the proprietor's duty in regard to the lighting of a common stair is fully satisfied by his providing the permanent fixtures necessary for lighting the stair—*i.e.*, the gas brackets and piping, and that it lies with the tenants on the stair to supply the illuminating material, as well as to attend to the regular lighting of the lamps at the proper hours. In the present case it appears that the defender—the proprietor—has provided fixtures as ordered by the Police Commissioners, and to their satisfaction, but he has refused to supply a gas-meter, and in consequence, as is alleged, of this refusal the stair has hitherto remained unlighted. The question, therefore, which I am really asked to decide is, whether the supply of a meter is the proprietor's duty or the tenant's. On this question I have no doubt or difficulty. The supply of a meter is the consumer's business. The Gas Commissioners are entitled to hold, and do hold, the party to whom a meter is issued liable for all the gas that passes through it, and therefore the defender could not supply a meter without rendering himself directly chargeable for the gas consumed on the stair, which, as I have already said, he is under no obligation to do. As I took occasion to observe when the case was last before me, the statutory provisions on the subject are not easily workable, and I think it would have been simpler and better if the Legislature had imposed on proprietors the duty of supplying gas to common stairs on their properties, leaving it to them to recover the expense from their tenants. I am glad to be informed by the clerk to the Gas Commissioners that comparatively little difficulty is experienced in the matter in Dundee, and that for the simple reason that the majority of the house proprietors have had the good sense to take the course which had suggested itself to me as the right and simple one. It was said for the defender, in explanation of his reluctance to adopt this course, that the tenants, having a fixed sum charged against them for gas, would have no interest to check waste, and would consequently be less likely to attend to the punctual extinguishing of the lamps. But, in the first place, there is no necessity for making the charge for gas a fixed one; and, in the second place, I am informed that the Gas Commissioners have offered, on payment of what is little more than a nominal extra charge, to give the services of the public lamplighters for lighting and extinguishing the lamps on common stairs. This would meet the defender's objection, and while I consider that he is under no legal obligation to do more than he has done, I think it would be well if in this matter he followed the course taken by the majority of the house proprietors in town."

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# Register of New Patents.

## APPLICATIONS FOR LETTERS PATENT.

4192.—JENNINGS, J. G., Lambeth, and POCOCK, A. W., Westminster, London, "Improvements in water-waste preventers." Dec. 3, 1875.

4265.—KIDD, J., Westminster, and HEARSON, C. E., Strand, London, "Improvements in gas-burners for burning hydrocarbon vapours and gases." Dec. 9, 1875.

## GRANTS OF PROVISIONAL PROTECTION.

4051.—CAMERON, J., Salford, "Improvements in the construction of steam-pumps." Nov. 22, 1875.

4059.—ARMSTRONG, R., KELLETT, H., and MACFEGGAN, W. S., Durham, "Improvements in pumps and in the apparatus to be used in connexion therewith." Nov. 22, 1875.

4061.—TELLIER, A. LE, Brussels, "Improvements in apparatus for purifying and filtering water and treating sewage." Nov. 22, 1875.

4068.—SCOTT, J. S., Temple, London, and POILLY, E. DE, Boulogne-sur-Mer, France, "Apparatus for the instantaneous lighting of gas-burners in towns, theatres, public rooms, private dwellings, and other places, applicable also as an automatic gas-gauge." Nov. 23, 1875.

4078.—FIRTH, J., Halifax, "An improvement in taps for fluids." Nov. 24, 1875.

4103.—WILDSMITH, J. H. S., Birmingham, "Improvements in the collection and treatment of human excreta and other refuse or waste animal substances used in the manufacture of artificial manure, and in the apparatus used therefor, parts of such improvements being also applicable to other purposes." Nov. 26, 1875.

4117.—LAKE, W. R., Southampton Buildings, London, "Improvements in the manufacture of illuminating gas and in apparatus therefor." A communication. Nov. 26, 1875.

4122.—BANNEHR, J., Gray's Inn, London, "Improvements in means for intercepting and treating excreta and other matters of sewage." Nov. 27, 1875.

4126.—BUTT, J. M., and HERRING, J., Gloucester, "Improvements in apparatus used in the purification of gas." Nov. 27, 1875.

## NOTICES TO PROCEED.

2884.—WIRTH, F., Frankfort-on-the-Maine, "Improvements in water-meters." A communication. Aug. 16, 1875.

3704.—CLELAND, W., Linacre, Lancs, "Improvements in apparatus used in the manufacture of gas made from coal, cannel, shale, and like materials." Oct. 26, 1875.

## PATENTS WHICH HAVE PASSED THE GREAT SEAL.

2131.—MAXWELL, N. M., Queen Victoria Street, London, "Improvements in the construction of taps or cocks." June 10, 1875.

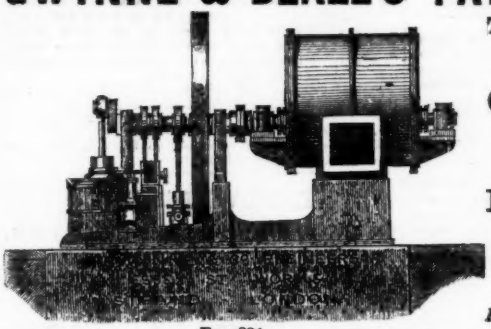
2183.—JOHNSON, J. H., Lincoln's Inn Fields, London, "Improvements in wrenches or spanners." A communication. June 14, 1875.

2270.—WRIGHT, J. R., Uddingston, Lanark, "An improvement in the construction of regenerative gas-furnaces." June 22, 1875.

3316.—BARTRUM, W. E., Streatham, London, "Improvements in rotary engines, pumps, or meters." Partly a communication. Sept. 22, 1875.

The GRAND MEDAL of MERIT at the VIENNA EXHIBITION has been AWARDED to

# GWYNNE & BEALE'S PATENT IMPROVED GAS-EXHAUSTERS,



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Ever produced, and the most economical in working.

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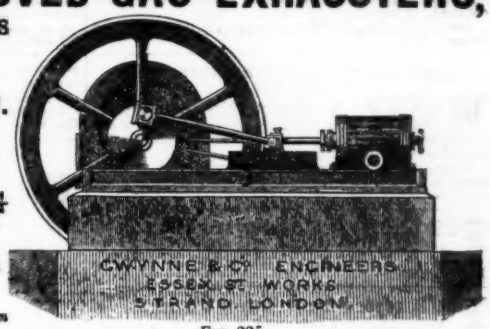



FIG. 224. FIG. 225.

Fig. 224 represents one of those erected at the Imperial Gas-Works, Bromley, capable of passing 210,000 cubic feet of gas per hour. Several others of the same size are now on order for the same Company. These Patent Machines combine the highest quality of workmanship and materials, the largest bearings and wearing surfaces, with the most perfect system of action yet discovered. Fig. 225 represents one of a series of four at the Nottingham Gas-Works, each passing 52,500 cubic feet per hour. GWYNNE AND CO. *do not pretend to enter into a struggle with other makers in respect to cheapness. They have never sought to make price the chief consideration, but to produce Machinery of the very highest quality, and the most approved design and arrangement.* Their prices have been estimated with a due regard to the excellence of the article produced, and when this is taken into consideration, they have no fear for the result. The orders executed this season for Exhausters and alterations to their patented system amount to over 4,000,000 cubic feet of gas passed per hour, and to over 300 horse power for Engines to drive them. In every instance their work is giving the greatest satisfaction. Numerous testimonials and references can be given.

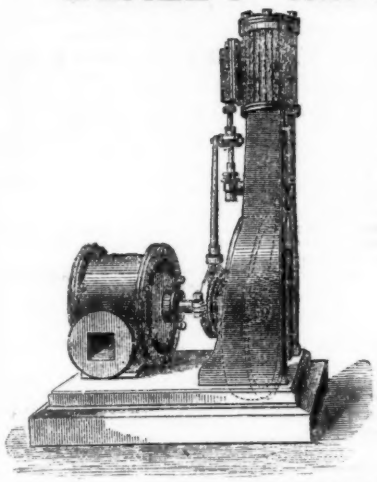
REGULATORS, BYE-PASSES, STOP-VALVES, GAS-VALVES, & MACHINERY FOR GAS MANUFACTURE, OF ALL SIZES,

CAN BE HAD ON APPLICATION TO

GWYNNE & CO., HYDRAULIC & GAS ENGINEERS, ESSEX STREET WORKS, STRAND, LONDON, W.C.

*G. & Co. are now manufacturing for a London Gas Company three of their 210,000 cubic feet Patent Gas Exhausters, and many of all sizes.*

# BEALE'S IMPROVED PATENT GAS-EXHAUSTER



WITH

ENGINE COMBINED

ON

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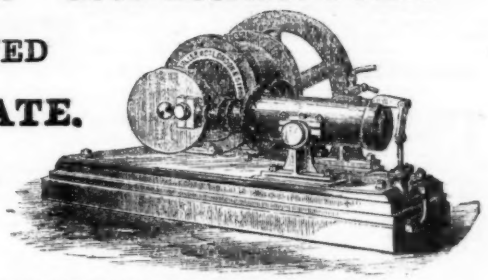
SOLE MAKERS,

GEORGE WALLER & CO.,

Who, since Mr. BEALE'S retirement, are the Oldest Makers.



EXHAUSTERS with HORIZONTAL ENGINE combined.
EXHAUSTERS with OUTSIDE BEARINGS.
MAKERS of ENGINES, BOILERS, and GAS MACHINERY.
TAR, LIQUOR, and SYPHON PUMPS. GAS-VALVES in stock, 2 to 30 inches.
SELF-ACTING BYE-PASS VALVES, with Lid and Relieving Lever.
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# D. BRUCE PEEBLES & CO.,

ENGINEERS,

FOUNTAINBRIDGE WORKS, EDINBURGH,

MANUFACTURERS OF WET AND DRY GAS-METERS;

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ABOVE 30,000 OF WHICH ARE NOW IN USE.

"These Lamp-Governors are so superior that they are likely to supplant all others."—*Dr. Wm. Wallace, F.R.S., F.C.S.*

D. BRUCE PEEBLES AND CO., FOUNTAINBRIDGE WORKS, EDINBURGH.

**WANTED**, an experienced Main and Service Layer.
For particulars apply to the MANAGER, FORFAR GAS-WORKS.

**WANTED**, the Management or Assistant Management of a Gas-Work. Five years practical experience in the manufacture and distribution of gas.
Address No. 214, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

**WANTED**, by the Ilfracombe Gas Company, a MAN who is thoroughly competent to take the entire charge of their works, engine, service-laying, meters, and gas-fittings.
Applications, with testimonials and salary, to be addressed to the CHAIRMAN of Directors.

NEW EDITION, NOW READY,

ADVANTAGES OF GAS FOR

COOKING AND HEATING.

By MAGNUS OHREN, A.I.C.E., F.C.S.

For Companies to issue to their Gas Consumers.

Specimen Copy by post Threepence, direct from MAGNUS OHREN, Gas-Works Lower Sydenham, London, S.E.

**A** Young Man, aged 21, at present (3 years) engaged as Collector (2000 consumers), keeps rental, time books, &c., assists in indices taking, and watering meters, requires a fresh situation. Good references.
Address S. H., 62, Beverley Street, Beeston Road, LEEDS.

**WANTED**, after Christmas next, a thoroughly competent MAN to take the entire charge of a small work. Make about 10 millions. Preference will be given to a man who is also competent to act as Secretary.
Applications, with testimonials and salary required, to be addressed to Messrs. WILLEY AND FORD, Gas Engineers, EXETER.

BOROUGH OF LEEDS.

GAS MANAGER.

**WANTED**, by the Council of this Borough, a MANAGER to reside at and superintend, under the direction of the Gas Engineer, the New Wortley Works, in Leeds. Salary £150 per annum, with house, coals, and gas free.
Applications, with testimonials, endorsed "Gas Manager," to be sent to my Office not later than Saturday, the 15th of January next. By order,
CAPEL A. CURWOOD, Town-Clerk.
Leeds, Dec. 16, 1875.

**WANTED**, by the Advertiser, a re-engagement as MANAGER of Gas-Works, with a yearly make of not less than 20 millions, or as Sub-Manager of large works. For several years Manager of a provincial work, and has carried out considerable extensions in all branches. Good testimonials and references.
Address No. 227, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

OVER DARWEN LOCAL BOARD.

GAS AND WATER DEPARTMENT.

**WANTED**, a steady industrious Man as SMITH, Main and Service Layer, and Meter Fixer, and who is thoroughly accustomed to the routine of a Gas-Work. Testimonials required.
Apply to JOHN MARSLAND, Engineer and Manager.

GAS-WORKS TO BE LET.

**TO BE LET**, on Lease, for a term of years, the Lower Gornall Gas-Works, Staffordshire.
The works are situated in a very populous neighbourhood, are fitted up with every requisite, are in full operation, and the make of gas and the number of consumers are steadily increasing.
Possession may be had on the 1st of January next, when the present lessee's term expires.
Apply to Mr. F. KENNING, Secretary, District Gaslight Company, Limited, 21, Darlington Street, WOLVERHAMPTON.

**WANTED, by a Gas Manager of 20** years experience, the management of medium-sized works. Is practically acquainted with engines and exhausters, gas-making and purifying, also main and service laying, &c. Can carry out any alteration or erection required. Aged 40.

Address No. 229, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

CORPORATION GAS-WORKS, ABERAVON, SOUTH WALES.

**WANTED, a thoroughly competent** FOREMAN or Working Manager for the above works, who understands the manufacture and distribution of gas, retort-setting, and gas-fitting.

Apply, stating salary expected, and with copy of testimonials, to the TOWN-CLERK, Aberavon, SOUTH WALES, on or before Monday, Dec. 27, 1875.

**FOR SALE—A 6-in. Governor, in good** condition. Now replaced with a larger one.

Apply to Mr. WILLIAM DUFF, Manager, Gas-Works, MORECAMBE.

**FOUR second-hand Lime Purifiers, in** moderately good order, and of about 5 ft. square, Wanted.

Address Sussex Chemical Works, SHOREHAM, with price and particulars.

**THE Directors of the British Gaslight** Company, Limited, are in want of a Gentleman as MANAGER of their Norwich Station. Salary £450, with house, &c.

Applications, with copies only of testimonials, to be addressed to the SECRETARY, at the Chief Office, 11, George Yard, Lombard Street, LONDON, on or before Tuesday, the 4th of January, 1876.

**THE "Compagnie Genevoise de l'In-**dustrie du Gaz" are prepared to receive OFFERS for the erection of a single GASHOLDER, capacity 20,000 cubic feet, diameter 40 feet, depth 17 feet, in next summer, at its Gas-Works of Mentone, Department Alpes Maritimes, France.

Tenders, indicating price, including columns and girders, to be directed to M. CHANTRE, Engineer of the Company, Gas-Works of Bologna (ITALY).

**MANCHESTER CORPORATION GAS-WORKS.**

ADDITIONAL WORKS.

**THE Gas Committee of the Corporation** invite competitive Plans for intended ADDITIONAL WORKS, to be erected on land situate near Bradford Road, Manchester. The following premiums will be awarded to three plans to be selected—viz., £500, £300, and £200, which plans will become the property of the Corporation.

The Committee do not bind themselves to engage any of the competitors to carry out the works.

The competitive plans must be addressed to the Chairman of the Gas Committee, at the New Town-Hall, Manchester, and be delivered there before Four o'clock in the afternoon of Tuesday, the 21st day of March next.

Lithographed plans of the site, and instructions with regard to the competition, may be obtained from Mr. Thomas Peacock, at the Gas Offices, New Town-Hall. Cooper Street entrance.

On behalf of the Gas Committee,
JOSEPH HERON, Town-Clerk.

New Town-Hall, Dec. 17, 1875.

**SZERELMEY Liquid Enamel, for Iron-**work exposed to the atmosphere, supersedes paint, dries in two hours, absolutely prevents rust, contains no oil, requires no mixing, is ready for use, is laid on like paint, covers new or old iron or wood, old paint, tar, or whitewash, is waterproof, gives a fine polished surface, and costs scarcely one-fourth as much as paint—namely, one halfpenny per square yard. Samples to any address for 12 stamps. Particulars free on application.

**SZERELMEY Iron Paint has stood the** test of 24 years experience. The gilding on the Victoria Tower of the Houses of Parliament was laid on over it upwards of 20 years ago, and is still in perfect condition.

**SZERELMEY Stone Paint thoroughly** waterproofs brick and other walls without giving them the appearance of having been painted.

**COPIES of Reports on the Szerelmey** compositions, by Sir Charles Barry, Sir R. J. Murchison, and Professor Faraday (printed by order of the House of Commons), with other information, may be had on application.

**NONE of the Szerelmey compositions** contain white or red lead, arsenic, or any other injurious ingredient. When in use and while drying they have a purifying effect on the atmosphere.

**SZERELMEY Liquid Enamel.—The cost** of the Enamel when laid on is about one halfpenny per square yard. We are now entering orders for execution at any time before the end of March, at £25 per ton, subject to a liberal discount for cash, particulars of which we will send, if asked. A ton measures about 125 gallons, and is ready for use.

**SHIPPERS will receive liberal treat-**ment at our hands. They will find that our Enamel Paste can be supplied for shipment at a price with which no ordinary paint can compete.

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**STOKING MACHINE PATENT FOR** SALE; undoubtedly one of the simplest and most effective machines of the kind invented.

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**STATION-METER for Sale, in good** condition (Makers West and Gregson) in very ornamental case, fitted up with tell-tales, inlet, outlet, and bye-pass valves, and 12-in. connexions. Passes 25,000 cubic feet per hour. Now replaced with a larger one.

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NOTICE TO THE PUBLIC.
BRONNER'S IMPROVED SYSTEM IN GAS LIGHTING.

**MESSRS. HENRY GREENE AND SON,** 155, CANNON STREET, LONDON, sole consignees for Great Britain and Ireland of BRONNER'S IMPROVED SYSTEM IN GAS LIGHTING, beg to inform the public that JULIUS BRONNER, of Frankfort-on-Maine, in the Kingdom of Prussia, Manufacturer, has, of this date, 9th of November, 1875, obtained interdict before the Court of Session in Scotland, against R. M. Brechin and Company, Gas-Fitting Manufacturers, 46, Hanover Street, Edinburgh, and R. M. Brechin, the only known partner of the said firm, interdicting, prohibiting, and discharging the said R. M. Brechin and Company and R. M. Brechin from in any way advertising or offering for sale, or selling, or from in any way causing to be advertised, or offered for sale, or causing to be sold as "Brönner's Burners," any burners not manufactured by the said Julius Brönner, or from in any way endeavouring to induce the public to believe that the said R. M. Brechin and Company, or R. M. Brechin, sell or keep for sale "Brönner's Burners" manufactured by the said Julius Brönner, while such is not the case.

Further, the said Julius Brönner, on the 20th of April, 1875, in a suit in Chancery, 1874, B 365, instituted by him against a defendant who had been selling such Burners, obtained an injunction perpetually restraining the defendant, his agents, servants, and workmen, from in any way advertising or offering for sale, or selling, or from in any manner causing to be advertised or offered for sale or sold as "*Real Bronner*," or "Brönner," or "Broehner" Burners, any Burner not manufactured by or for the plaintiff, Julius Brönner, or by his agents.

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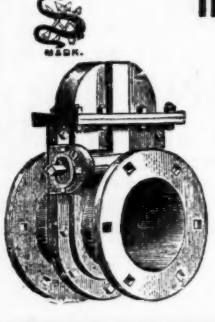


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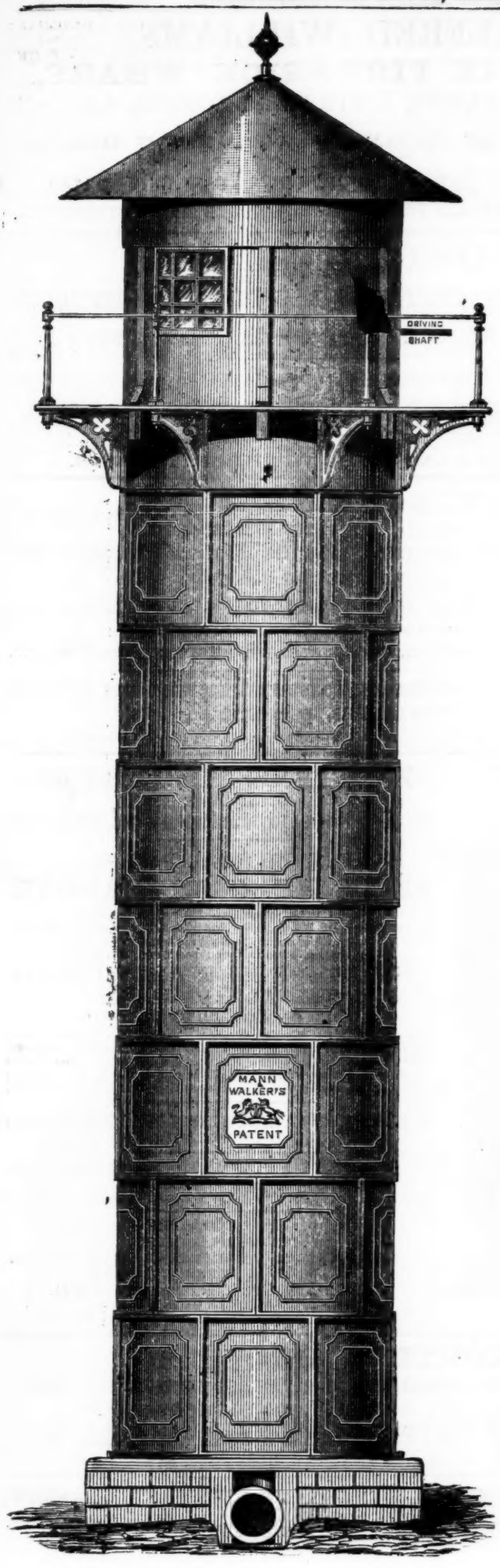


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**By their use the department of purification** from ammonia upon a gas-works is made complete, without the aid of prepared oxide of iron, chemicals in purifiers, or any other supplementary process, and the whole ammoniacal residual product contained in the coal is absorbed and obtained in the form most profitable to a gas company, while the requirements of all Acts of Parliament and of the Board of Trade, relating to incorporate gas companies, are satisfied.

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**J. C. SELLARS** respectfully calls the attention of such of his patrons who are Engineers and Managers of Gas-Works, also Architects and Builders, to his system of building with HARDENED SHELL-STONE BLOCKS, as forming, when "filled in," the neatest, strongest, most durable, and economical buildings ever introduced. The Blocks have a hard smooth stone appearance; their size is 18 in. in length, 9 in. in depth, and, as may be desired, 9 in. or 14 in. in width.

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*Pamphlet on Application.*

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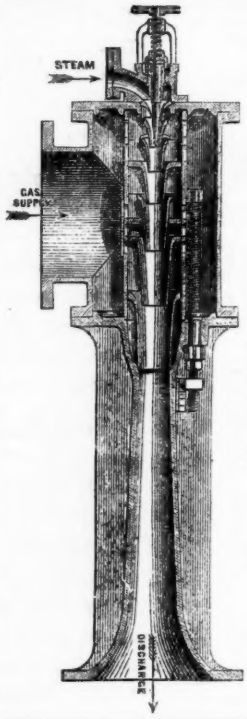


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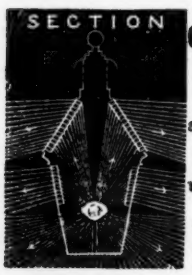

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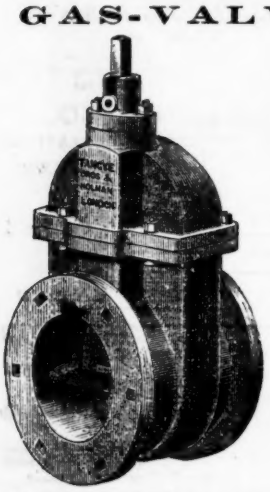

| Inch. | s. | d. |
|---|---|---|
| 3 | 25 | 0 |
| 4 | 36 | 0 |
| 5 | 40 | 0 |
| 6 | 54 | 0 |
| 7 | 63 | 0 |
| 8 | 80 | 0 |
| 9 | 85 | 0 |
| 10 | 100 | 0 |
| 12 | 120 | 0 |
| 14 | 140 | 0 |

**TANGYE BROS. & HOLMAN,**
LAURENCE POUNTNEY LANE,
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**J. & J. BRADDOCK,**
GAS ENGINEERS,
**GLOBE METER-WORKS, OLDHAM,**
MANUFACTURERS OF
WET & DRY CONSUMERS GAS-METERS,
OF THE HIGHEST EXCELLENCE;
ALSO LICENSEES AND MANUFACTURERS OF
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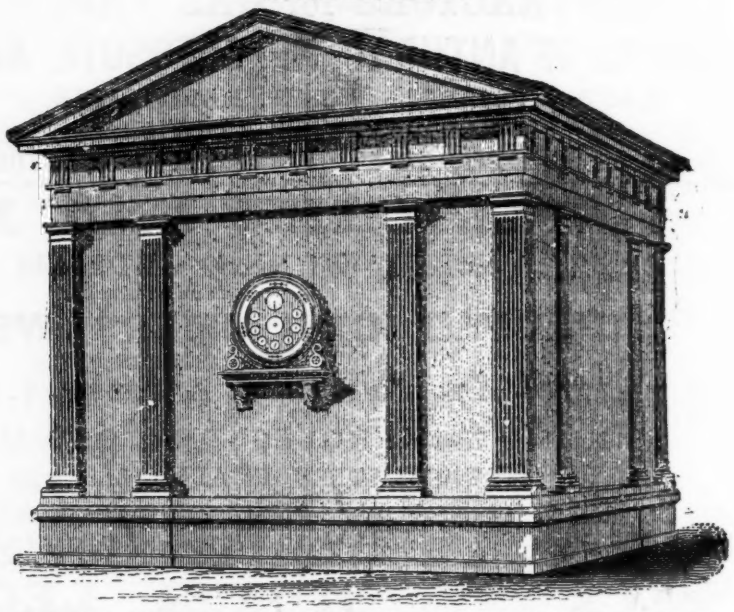
**ROUND STATION-METERS,**
ON CAST-IRON STANDS.



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GAS COOKING APPARATUS.
Home and Foreign Orders promptly attended to.
All Sizes of CONSUMERS METERS, STATION-METERS, and GOVERNORS generally in Stock.
*Orders almost invariably despatched on the day of receipt.*
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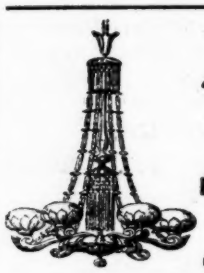

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MANUFACTORY AND SHOW-ROOMS:
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**STEAM-ENGINES and EXHAUSTERS,** separately or combined.
**FOUR-WAY VALVES,** one of which is equal to three ordinary Valves.
**STATION GOVERNORS**—the Gasholder cannot tilt and cause accident.
**BREEZE AND TAR FUEL MACHINE.**

A Pamphlet containing Eighteen Illustrations of the foregoing, with letterpress of the construction of Works, post free, 2s. 6d.
N.B.—The second edition of this Work, *now ready*, contains Illustrations of the Machine for converting Breeze and Tar into Fuel for heating the Retorts.
"The Author is well qualified to speak authoritatively upon the important subjects to which his pamphlet refers."—*Artisan.*

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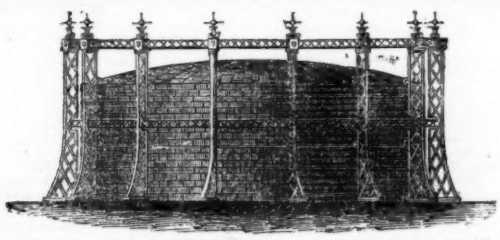

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**GAS OR WATER WORKS;**

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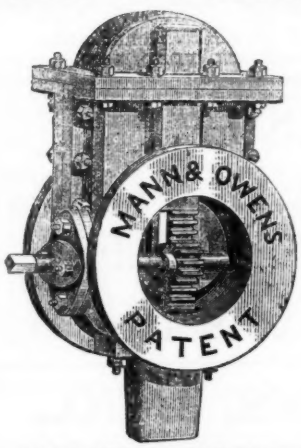


RACK AND PINION VALVE.

SCREW VALVE.

The advantages of this Patent Valve over all others yet introduced are, that it is always as tight as the best wedge or spring valve, without the possibility of setting fast or becoming suddenly leaky. The surfaces not being in contact during the operation of opening or closing, leakage through wear and tear is avoided.

The Gas Engineer will not fail to see the importance of such a valve in connexion with his purifying apparatus, particularly in the case of large sizes.

The slide being operated either by a screw and nut, or by a pinion and rack, a cam bearing upon a plane, cast on the back of the Valve, forces it against the face, and renders the escape of gas an impossibility. By a slight turn of the pinion or screw, the slide is released, and brought away from the face, by which means friction is avoided, and the only force required to open the Valve is that due to its own weight.

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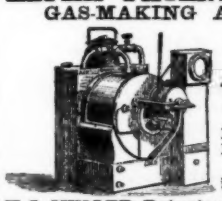

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Specially constructed for Country use.

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Larger and smaller sizes in course of construction.

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PREVENTS WASTE OF GAS FROM RETORTS;

SAVES CLAY RETORTS FROM DESTRUCTION BY FIRE;

GREATLY ECONOMIZES THE USE OF FIRE-BRICKS;

And PREVENTS ALL POSSIBLE LOSS of GAS FROM LEAKAGE.

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*Prices on application.*

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**LOTHIAN'S CANNEL**

Yields 12,500 cubic feet of 34-candle gas per ton, and 9 cwts. of excellent coke, containing only 4 per cent. of ash.

**MUIRKIRK, No. 1, CANNEL**

Yields 12,160 cubic feet of 32·5-candle gas per ton, and 10 cwts. of excellent coke, containing only 5 per cent. of ash.

**OLD WEMYSS CANNEL**

Yields 13,320 cubic feet of 32·5-candle gas per ton.

*Prices and full Analyses on application.*

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**BICKERSHAW PITS, WIGAN,**

Of the Abram Colliery Company, are worthy the attention of gas producers, showing a good yield of gas and a large residuum of excellent coke. When blended with one-seventh cannel, the gas is of specially high illuminating power.

Copies of analysis made at the Gas-Works, Salford, with an apparatus of full size, prices, and particulars of

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*Analysis and Price on Application.*

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Supply and Contract for all the principal Scotch Gas Coal (including BOGHEAD, HARTHILL, CHAPELSIDE, LESMAHAGOW, and BRAEHEAD), f.o.b., or delivered at home or abroad.

ENGLISH AND WELSH COAL AND CANNELS ALSO SUPPLIED.

*Analyses and Prices on application.*

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## AXWELL COLLIERY COMPANY,

**Near NEWCASTLE-ON-TYNE,**

**SUPPLY CANNEL COAL FROM THE ABOVE COLLIERY.**

Analysis—10,000 cubic feet of Gas per ton of Coal, having an illuminating value equal to 26 standard sperm candles, with a yield of 13½ cwts. of Coke per ton of Coal.

Supply also Gas and Coking Coals from the best seams.

Shipments at Tyne Dock and South Dock, Sunderland.

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**GAS COAL.**

**POPE & PEARSON, LIMITED,** have now the authority of several of the most eminent Gas Engineers of London in stating that their Coal yields *in practical working over* 10,000 *cubic feet of gas, with an illuminating power of* 16 *candles;* or by the standard burners now used by the London Gas Companies, an illuminating power equal to 17½ candles.

One ton yields 12¼ cwt. of good coke. This Coal can be shipped from Hull, Goole, Liverpool, Morecambe, and Barrow.

For further particulars, apply to POPE AND PEARSON, LIMITED, West Riding and Silkstone Collieries, near LEEDS.

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The Subscriber is prepared to contract for the supply of all the principal SCOTCH CANNEL COALS. Prices and Analyses of the various Coals will be forwarded on application.

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## Scotch Churls

PRESENT PRICE:

5s. 6d. per Ton at Pit.

8s. 9d. ,, F.O.B.

| Cubic Feet. | Illuminating Power. | Coke (sup. qual.). |
|---|---|---|
| 10,000 .. | 20 candles. .. | 12 cwt. |

## C. & W. WALKER'S WOOD PURIFIER SIEVES,

Which have now been used for fifteen years, and their advantages and durability fully established. They are made entirely by steam machinery in very large quantities at the most moderate cost.

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**CANNEL COAL.**

## COPPA COLLIERY, MOLD,

Beg leave to call the attention of Gas Companies to the superior quality of their

**CANNEL FOR GAS-MAKING PURPOSES.**

This Cannel produces in actual working, in iron retorts, 9200 cubic feet of 32-candle gas, and upwards of 11 cwt. of coke, and in clay retorts will produce 11,500 cubic feet of 25·9-candle gas.

Ports of shipment—Birkenhead or Connah's Quay.

Waggons supplied for delivery by railway to any part of England or Wales.

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## FRAMWELLGATE COAL COMPANY,

**DURHAM,**

Are prepared to supply their

**SCREENED AND NUT GAS COALS.**

This Coal yields 11,000 cubic feet of gas and 13½ cwts. of coke per ton.

OFFICES: ROYAL EXCHANGE, MIDDLESBROUGH.

**GEORGE FLINTOFF, C.E., 4. Spring** Gardens, Charing Cross, London, who originated the cheap gas movement in London and the provinces in 1848, ERECTS and ENLARGES GAS-WORKS. May be consulted in Valuations, Rating Cases, Public Lighting, and all matters relating to the supply of gas.

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**COTTERILL'S PATENT STEEL TUBE-DRILLS,** for connecting services to water-mains *under pressure*, without turning off the water. They drill and tap themselves, and are left in the mains. Made of all sizes, from ½ to 2 inches and upwards. They cost less than the ordinary plan.

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As supplied to the Imperial, Chartered, and other London and Provincial Gas Companies. Bellows and Valves for inflating Well Dresses, Stokers Gloves, India-Rubber Suction and Delivery Hose, Gas-Tubing, Leather, India-Rubber and Gutta-Percha Machine-Bands, Sheet and Washers and Steam Joints.

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# THORNCLIFFE IRON-WORKS AND COLLIERIES,

## NEAR SHEFFIELD,

STRONGLY RECOMMEND A TRIAL OF THEIR

# CELEBRATED SILKSTONE GAS NUTS.

**Analysis by F. J. EVANS, Esq., Chartered Gas Company, Horseferry Road, Westminster:—**

(COPY.)

| | Cubic Feet of Gas per Ton of Coal. | Illuminating Power in Candles. | Coke per Ton of Coal used. | Ash in Coke, per Cent. | Sulphur in Coal, per Cent. |
|---|---|---|---|---|---|
| Silkstone Nuts . . . | 10·800 .... | 15·85 .... | 12·66 cwt..... | 6·0 .... | 0·69 |

NOTE.—The illuminating power of the gas was tested by the standard burner now used in London by the Gas Referees, under the City of London Gas Act, 1868.

*Horseferry Road, Westminster, March,* 1870. (Signed) F. J. EVANS.

These Nuts are extensively used by various Gas Companies throughout the Kingdom, who bear strong testimony to their value.

***APPLICATIONS FOR PRICES, &c., TO BE SENT DIRECT TO THE COLLIERY, AS ABOVE.***

# GAS PURIFICATION & CHEMICAL Co., LIMITED,

(Successors to JOHN WILLIAM O'NEILL & CO.,)

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## CONTRACTORS FOR GAS PURIFICATION BY OXIDE OF IRON.

The superiority of the material supplied by this Company is generally recognized, and it is now in use in nearly all the London and most of the large Provincial Gas-Works.

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THE DERBYSHIRE

## SILKSTONE COAL COMPANY, LIMITED,

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## GAS COAL

**Of superior quality, delivered at any station in England and Wales.**

| | |
|---|---|
| Purified gas per ton of coal in cubic feet (average) . . . . . | 10,775 |
| Weight of coke in lbs. per ton of coal . . . . . | 1,465 |

ANALYSIS AND PRICES ON APPLICATION TO

Mr. EDMUND TAYLOR, Secretary,

ALBERT COLLIERY, NEWBOLD, NEAR CHESTERFIELD.

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# THE LOCHORE AND CAPLEDRAE CANNEL COAL COMPANY, LIMITED.

Works: LOCHORE by LOCHGELLY, FIFESHIRE. Office: 19, MAITLAND STREET, EDINBURGH.

This Company request attention to the very superior quality of their Cannel Coals.

1. The following are the practical results given by Dr. Wallace, of Glasgow, of analyses of their Lochore and Capledrae Cannels:—

| | Sample worked at Capledrae. | | Sample worked at Lochore |
|---|---|---|---|
| Gas per ton of coal, at 60° Fahr. and 30 inches barometric pressure . . | 13,095 cubic feet. | .. | 11,760 cubic feet. |
| Illuminating power, in standard sperm candles, by union jet consuming 5 cubic feet per hour, at ·5-inch pressure . . . . . | 32·91 | .. | 34·83 |
| Value of 1 cubic foot of gas in grains of sperm . . . . . | 780 | .. | 836 |
| Equivalent of a ton of coal in pounds of sperm candles . . . . . | 1,459 | .. | 1,404 |
| Durability of 1 cubic foot by 5-inch flame . . . . . | 69 minutes. | .. | 71 minutes. |
| Gravity of the gas (air = 1000) . . . . . | 596 | .. | 594 |

*Remarks.*—This (the sample from Capledrae) is a Cannel Coal of first-class quality, giving 13,000 feet of 33-candle gas. It contains only a minute proportion of sulphur, and the ash is almost quite white. The coke is of rather inferior quality.

*Remarks on Sample from Lochore.*—This is a Cannel Coal of first-class quality, giving a large yield of very rich gas and a coke of medium quality.

2. The following are the practical results of analyses by Dr. Wallace of the Company's Waverley Cannels:—

| | Capledrae Waverley. | | Lochore Waverley. |
|---|---|---|---|
| Gas per ton of coal, at 60° Fahr. and 30 inches barometer . . . . | 9,120 cubic feet. | .. | 11,145 cubic feet. |
| Illuminating power, in standard candles, by union jet consuming 5 cubic feet per hour, at ·5-inch pressure . . . . . | 36·62 | .. | 33·09 |
| Value of 1 cubic foot of gas in grains of sperm . . . . . | 878 | .. | 794 |
| Equivalent of a ton of coal in pounds of sperm candles . . . . . | 1,145 | .. | 1,264 |
| Durability of 1 cubic foot of gas by 5-inch flame . . . . . | 80 minutes. | .. | 67 minutes. |
| Gravity of the gas (air = 1000) . . . . . | 677 | .. | 597 |

*Remarks on the Sample of Capledrae Waverley.*—This Coal gives fully 9000 feet of gas of 36½ candles, and is admirably adapted for bringing up the quality of gas made from common coal or inferior qualities of cannel. The tests were made at a rather high temperature, this being one of the coals that stand a very high heat without serious diminution of the illuminating power of the gas The coke contains 60 per cent. of ash, and is therefore almost valueless, but the proportion of sulphur is very moderate.

*Remarks on the Lochore Waverley.*—This is a first-class Cannel Coal, giving 11,000 cubic feet of 33-candle gas. The quantity of sulphur is very minute, and the ash is nearly white. The coke is of inferior quality, but not wholly valueless.

*Applications for full Copies of Analyses and Prices may be made to the Company, at*

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# UNVARYING WATER-LINE GAS-METER.

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"Unquestionably the best Water Gas-Meter now in use."—Thos. G. Barlow, C.E.

Over 90,000 in action.

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Branch Manufactories at DUBLIN and OLDHAM.

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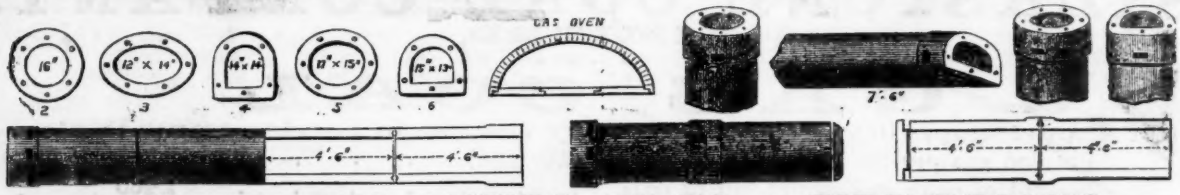
## FIRE-CLAY AND BRICK WORKS, STOURBRIDGE.

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A LARGE ASSORTMENT OF GAS-RETORTS IN STOCK.

STOCK FOR EXPORT READY AT THE WORKS, AND AT ELLESMERE PORT.

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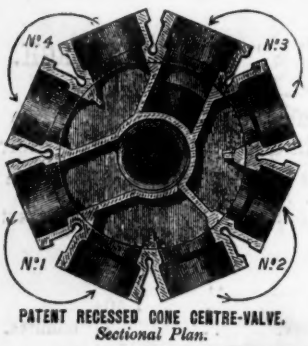


PATENT RECESSED CONE CENTRE-VALVE.
*Sectional Plan.*

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## EDINBURGH AND GLASGOW.

SOLE MAKERS OF

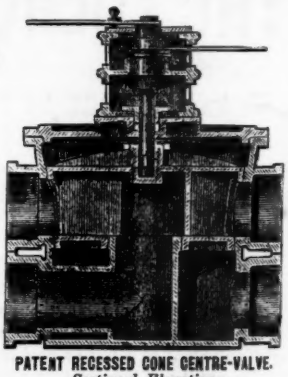
PATENT

RECESSED CONE CENTRE-VALVES,

Constructed on the principle of the ordinary Plug-Cock.

THROUGH-WAY & FOUR-WAY COCKS

Of all descriptions.



PATENT RECESSED CONE CENTRE-VALVE.
*Sectional Elevation.*

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Invite the attention of Gas Companies and the Trade generally to their Improved GAS-METERS, which they warrant equal to any in Quality, Workmanship, and Simplicity of Construction, and the only Meters from which Gas cannot be obtained without being duly registered.

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DOUBLE CONE, ALBERT, SHADOWLESS, & EVERY DESCRIPTION OF BURNER, UNION JETS, BATSWINGS, ETC.;

IMPROVED FULL-WAY CARTER'S VALVES (much approved of);

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for clearing out Mains, Services, and Interior Fittings—70s. net.

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London: Printed by William Brewster Kent (at the office of Clayton and Co., 17, Bouverie Street, Fleet Street); and published by him at No. 11, Bolt Court, Fleet Street, in the City of London.—Tuesday, December 21, 1875.